EFFECTS OF INDUSTRIAL WASTE ON RIVERS

AN ANNOTATED BIBLIOGRAPHY

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PART I

INTRODUCTION

Industrial and technological revolution is taking place in our country to achieve better quality and quantity of food, housing, transportation and sanitation. This technological progress along with the population explosion and urbanization has polluted our air, water and soil with man made hazards to public health. These hazards are in the form of synthetic, industrial and agricultural chemical, toxic compounds, industrial and community waste products, new sources and kinds of energy as well as psychological stress as crowding and noise. Environmental pollution is a world wide problem and scientists are engaged all over the world to control the hazard caused by industries and their wastes.

The 'Gate way of India', Bombay, which is one of the highly industrialized cities releases 1000 tonnes of deadly pollutants into atmosphere every day, out of which 36.4 per cent is carbon mono oxide, 9.8 per cent oxides of nitrogen, 9.3 per cent particulates and 8.1 per cent hydro carbons. The Thane Crack is showing signs of mercury pollution much above medically acceptable limits. Mercury pollution, in Japan, led to Minemata, the most horrible infectious disease suffered by man. The Mahim an industrial locality in the Maharashtra releases 328 million liters of domestic effluents and 20 million liters of industrial effluents daily. Bombay releases 2500 tonnes of garbage and 1363 million liters of untreated sewage into the sea every day.

Environmental pollution has made the sky and virtually overloaded sewer, and changed the fertile land into a barren land and rivers a poisonous sink. The only bright spot in this over all gloomy picture is that this growing mennace has led to a growing concern. among the people, the scientists, the engineers, the industry and the world governments to monito and control up to tolerable levels. This will surely be helpful to save an many life forms, like plants, animals, fish and most of all, the human race. In India, this growing concern has taken the shape of two legislations, 'The Water Act' and 'The Air Act', soon to be passed and implemented.

Pollution reduces the usefulness of air, water and soil which make up the main constituents of our planetary life. Pollution may be solid or liquid, and if liquid, may contain dissolved material or suspended matter as well as dissolved gases of apolluting character. Solid pollution may consist of and kind of solid material, such as sand, gravel, soil, ashes, cinders, clinkers; sweeping from any factory, mine, quarry, or house; any sludge or solid sewage matter; rubber, wood, paraffin wax, gelatine, straw, paper or paper pulp etc.

The role of automobile exhaust as a major source of gaseous pollutants consisting of carbon monoxide, hydrocarbons, aldehydes, alcohols and nitrogen oxide. The concentration of toxic gases are increasing in dangerous proportions and their effect on public health are evident. Polluted air produces sickness and chronic allergies, affects the growth and reduces the life span in human beings. Besides the industrial sources, the air is also polluted by domestic and natural resources. The rate of pollution is greater in the areas of dense human population.

The raw water drawn for different purposes from the rivers is heavily polluted due to the industrial world. The industries situated along the stretch of rivers discharge their wastes directly into them either treated or untreated through sewage changing the composition of the stream. India is an agricultural country and her population obtaining water mainly from rivers, canals, lakes, ponds and wells for drinking and irrigation which is causing great hazard for public health and soils productivity. In view of high population it is necessary to have proper control on industrial effluents and water ways.

It is apparent that pollution, so far as rivers are concerned, can have two meanings, namely (1) the act of polluting or fouling the stream, and (2) the actual impurity or contamination introduced in to the water c course. It may happen that substances not normally regarded as polluting can, under special circumstanes, become so. Nitrates which are present in well purified sewage effluents and so find their way to streams, provided an interesting example. Firstly, under certain circumstances, nitrates can stimulate the growth of algae to such an extent as to cause the water become objectionable.

Chemical pollution, due to the presence of organic or inorganic substances, is, in general, the commonest type of pollution and the most intractable. Oil in a stream, though perhaps strictly a physical form of pollution but requires greater vigilence on the part of refineries. Oil spills from tanker may become threat to aquatic and land life.

It is not easy to give precise diefinition of 'pollution' or of the word "Polluting". If a river is turbird, or coloured or contians visible suspended or floating matter or has an objectionable smell, then it is rightly regarded by the average person as "polluted".

The word 'pollution' is derived from the Latin word "pollutus" which means "to soil" or "to defile". Thus pollution is the act of polluting or condition of being polluted; unclean-ness or impurity caused by contamination;

Coulson and Forbes gave a definition of "pollution" having special application in common law; 'the addition of something to water which changes its natural qualities so that the reparian proprietor does not get the natural water of the stream transmitted to him'. They then give three typical examples of pollution which illustrate this definition and which have formed the basis of succesful legal action viz.

(i) addition of hard water to soft water.

(ii) the raising of the temperature of water, and

(iii) the addition of some thing, which on meeting some other substance already in the water, each in themselves harmless, causes pollution.

Obviously the term 'pollution' as defined in common law has its widest and broadest significance, but it certainly has a some what narrower meaning in the various statutes dealing with pollution.

From the scientific stand point, it is perhaps easier to regard pollution as the actual impurity introduced into the stream rather than the act of introducing such impurity, and to define pollution as 'anything causing or inducing objectionable conditions in any water course and affecting adversely any use or uses to which the water thereof may be put'.

Since pollution markedly affects the flora and fauna of a stream and can alter the number of individuals as well as the number of species, it can also be defined in relation to its effects on plant and animal life in the river. In the state of california, U.S.A., the new control laws since 1950 make a distinction between 'contamination' and 'pollution'. 'Contamination' is regarded as 'the impairment of water quality by sewage or industrial waste causing an actual hazard to public health or an equivalent effect, whether or not waters of the state are affectd'; power to take immediate action is given in this case as a direct menace to public health is involved. On the other hand, 'pollution involves the introduction of any thing which 'adversely and unreasonably impairs the beneficial use of water even though actual health hazard is not involved. The reason for separating the two categories evidently derives from the much greater need for speedly action in cases where a potential danger to public health is involved. Pollution may be solid or liquid, and if liquid, may contain dissolved material or suspended matter as well as dissolved gases of a polluting character.

Solid pollution may consist of any kind of solid material, such as sand, gravel, soil, ashes, cinders, *clinkers, sweepings from any factory, mine, quarry, or house, any sludge or solid sewage matter; any vegetable or other garbage; offal or parts of the carcase of any animal; rubber, wood, paraffin wax, gelatine, straw, paper pulp, and even bread and butter.*

The commonest form of pollution causing the most trouble to river anthorites, however, is liquid (which includes solids in suspension), and this is generally caused by the discharge of sewage and industrial wastes into rivers.

The various organic compounds and materials can be broken down by micro organisms present in river water, and dissolved oxygen is used up in these reactions. Even toxic substances, such as phenols and cyanides, can suffer break down in this way, provided that they are present in sufficiently low concentrations.

If the organic pollution load is small and the dilution by well oxygenated stream water is high sufficient dissolved oxygen may be present to enable certain bacteria-aerolic bacteria which require free oxygen - to break down the organic matter completely to relatively harmless and odourless end products. The river thus recovers naturally from the effects of pollution and is said to have undergone 'self purification'. The oxidation reactions which occur are as follows:-

$C \rightarrow CO_2$ and normal and bi carbonates

$H \rightarrow H_2O$

$N \rightarrow$ Nitrates (e.g. $NaNO_3$)

$S \rightarrow$ Sulphate (e.g. $Na_2\ SO_4$)

$P \rightarrow$ Phosphates (e.g. $Na_2\ H\ PO_4$)

Often, however, massive pollution by organic matter casuses exhaustion of the dissoloved oxygen. The remaining organic matter is then broken down by a different set of bacteria - the anaerobic bacteria which do not require free oxygen but can utilize combined oxygen in the form of nitrates, sulphates, phosphates, organic compounds etc. Putrefaction then occurs, resulting in the breakdown of organic matter to a different set of end products, some of which (e.g. organic amines, organic sulpher compounds, sulphuretted hydrogen, phosphine etc.) have objectionable odours and may be the cause of complaints:

$C \rightarrow CH_4$
methane

$N \rightarrow NH_3$ and organic amines
ammonia

$S \rightarrow H_2S$ and organic sulpher compounds
hydrogen sulphide

$P \rightarrow PH_3$ and organic phosphorous compounds
phosphine

If fish are present in a river receiving a heavy organic load, there may be mortality when the dissolved oxygen falls below a certain critical level in the case of many fish this is about 57% of saturation or about 5 p.p.m. of dissolved oxygen.

The commonest toxic inorganic substances are free chlorine, ammonia, sulphuretted hydrogen and soluble sulphides, and the salts of many heavy metals (e.g.copper, zinc, lead, nickle, vanadium etc.). Any appreciable amount of these compounds may hinder or even prevent self purification of rivers and may kill fish and other aquatic life whether animal or vegetable. According to Fair and Whipple the concentrations of copper sulphate that will kill trout, perch and black bass are 0.14, 0.75 & 2.1 p.p.m. respectively. Many algae are destroyed by quite minute doses of copper sulphate. Fair and Whipple state that some blue green algae are killed by as little as 0.1 p.p.m. of copper sulphate whilst other algae may require 10-20 times this dose for destruction. A striking example of the devastating effect of traces of copper on biological life in streams is given by Butcher. He showed that effluents discharging to the river Churnet from a copper works (giving a copper concentration of 1-2 p.p.m in the river) completely exterminated all animal life for a distance of over 10 miles, and even sewage fungus was absent or very rare and algae were extremely rare.

Zinc is another heavy metal that is very toxic to fish.

Schott has reported that, owing to an increase in the free carbon dioxide of the water supply to fish tanks containing trout, sufficient zinc was dissolved from newly galvanized pipes to give a zinc concentration of 0.15 ppm which powered fatal to the fish. The author has an expenience of a number of cases of mortality amongst fish caused by the presence of traces of zinc in solution. On one occasion when some unwanted old smoke bombs containing zinc carbonate were dumped into a lodge, sufficient zinc (1-2 p.p.m.) passed into solution to casue the death of many coarse fish in the lodge. Many industrial effluents (e.g. Viscose rayon wastes, wastes from rubber fact~~ions~~ories, wastes from the manufacture of zinc compounds) contain considerable quantities of zinc.

Salts of heavy metals appear to bring about the death of fish by coagulating the mucus around the gills with the result that the fish are asphyxicated. Certain metals (e.g. zinc) are much more toxic to fish in soft waters than in hard waters.

It is important to remember that the effect of toxic substances on fish food may be a vital factor in determining whether fish can flourish or survive in a polluted stream, as in many cases the lower organisms upon which fish depend for food are even more susceptible to a particular poison than are the fish themselves. For instance water fleas (Daphnia magna) are adversely affected by as little as 0.1 p.p.m. of chromium (present as sodium chromate) whereas the lethal dose of chromate for fish is at least 20 p.p.m.

In the highly industralized areas, many of the rivers and streams are polluted by a great variety of treated and untreated industrial waste waters. It may contain waste waters from tanneries, fellmongers and leather dressers; food processing; rubber proofing, gas work, tar-distilling, electroplating, iron pickling, coal washing, sand washing, slaughter houses, calico printing and from the manufacture of batteris, paint, light alloys, plastics, rayon, dyes, chemicals, glue, glatine, paper pulp and paper.

Trade waste waters are divided into the following three groups:-

(I) Wastes which are polluting mainly on account of the presence of suspended matter e.g. waste waters from coal washing, sand and gravel washing.

(II) Wastes which are polluting partly because of the presence of suspended matter and partly on account of the presence of substances in solution. e.g. tannery, textile, dairy and beet-sugar wastes.

(III) Wastes which are polluting mainly on account of the presence of substances in solution e.g. gas liquor *electroplating wastes, many chemical waste waters.*

The more important harmful effects caused by the discharge of sewage and trade wastes to rivers can be briefly summarized as follows:-

(i) Fermentable organic matter will decompose and cause deoxygenation of the stream water. Fish may be asphyxiated and ultimately when all dissolved oxygen has disappeared there will be objectionable smells due to hydrogen sulphite, mercaptans, organic aminesele.

(ii) Suspended matter will deposit on the river bed or behind weirs as sludge and cause silting up of the bed and possible flooding. If the suspended solids are largely organic in nature, putrefaction may occur and solid matter buoyed up by gas may rise to the top, resulting in floating masses of any kind blamkets the bottom of a stream, so interfering with the spawning of fish as well as reducing the number of animals which form the food of fish.

(iii) Corrosive substances (acids, alkalis) or toxic substances (e.g. cyanides, phenols, zinc, copper etc.) may kill fish, bacteria and other aquatic life, animal and vegetable. The resulting destruction of beneficial water bacteria may produce a sterile river which is unable to under go natural self purification. Such waters may prove dangerous to use for domestic purposes or for watering cattle.

(iv) Pathogenic micro - organisms may be discharged with sewage during epidemices. Trade wastes, as a rule, are free from pathogens, though anthrex bacilli may possibly occur in tannery wastes.

(v) Certain undesirable physical effects caused by the discharge of sewage and trade wastes are turbidity, discoloration, foam and radioactivity. Heated effluents discharged to rivers (e.g. from power stations) may cause harmful rises in temperature of the stream. This can lead to undesirable putrefaction in streams already polluted by organic matter, and may also cause destruction of fish in relatively unpolluted waters.

(vi) Substance causing tastes and odours in water may be present in certain trade wastes (e.g. phenols, oil refinery wastes) and may make the water either unfit for drinking purposes or else difficult and costly to purify by conventional water purification processes.

(vii) Sewage and many organic trade wastes may cause excessive growth of sewage fungus or other objectionable growths in a stream. These may choke the river bed or even the screens of river users, and may give rise to objectionable odours when they decompose.

(viii) Certain mineral constituents (e.g. calcium and magnesium) can cause excessive hardness in a river water making it difficult to use for certain manufacturing processes.

Pollution of rivers may take place as a result of natural causes not necessarily associated with the activities of man. Pollution of this kind, is generally small and intermittent, being often connected with adverse weather conditions.

The discharge of crude or partially treated sewage in to a river constitutes by far the commonest from of pollution. The discharge to the river are liable to contain large amounts of suspended matter due to flushing out of solid matter that had collected in sewers during relatively dry periods and the drainage from the scouring of roof and street surface.

In many unsewered rural areas and even in some sewered urban areas, there may be alarge number of isolated houses provided with septic tanks as the sole means of sewage treatment. Since septic tanks produce unsatisfactory influence which do not comply with the standard of sewage effluents. Much pollution of the smaller watercourse is caused in many of these areas, resulting in smell and constituting in some instances a potential danger to public health.

Industrial pollution reduces the usefulness of water and soil. The major sources of soil pollution are the agricultural industries, population and agglomeration. In agriculture, wide use of pesticide, commercial fertilizers and animal waste results in accumulation of undesirable substances in soil. Many of these substances remain there for years. They disturb the microbiology of soil and influence fertility levels. Some pesticides and other chemicals are absorbed by earthworm, and the animals of other species. These chemicals may not be toxic to man but can be highly toxic to birds and animal species which eat these worms. Thus they can endanger the lives of birds and animals and even our lives as through meat preparation they may enter in to our digestive system and then to blood.

Industrial wastes generally contain phosphorus, nitrogen, heavy metals, many organic pollutants like carbohydrates etc. coming from synthetic textiles, dairy, petroleum refining, synthetic pharmaceuticals, paints and varnish industries. There are many other industrial wastes like radio active wastes, food processing wastes, biological wastes and phenolic wastes.

Many industrial wastes contain corrosive inorganic acids or alkalis which can do extensive damage to a stream by breaking down its natural buffer system and altering its normal pH value. Acids are particularly objectionable in a stream on account of the corrosion they may cause to metal or concrete structures, pumps, etc., especially if the pH value of the stream falls below about 5.0. They may also liberate evil smelling sulfuretted hydrogen from sludge deposits and river mud. Acids and alkalis can destroy bacteria and other micro-organisms and so inhibit or even prevent self purification of a stream, they are also lethal to fish and other forms of aquatic life. According to Robert, Grindley and Williams fresh water fish usually thrive in waters having pH values lying between 5.0 and 8.5 but certain species are affected by more acid or alkaline conditions.

The common toxic inorganic substances are free chlorine, ammonia, sulfuretted hydrogen and soluble sulfides and salts of many metals. Fluorides have been recognised as toxic substances. In view of increasing commerical manufacture and use of chemicals refrigirants, plastics, insecticides and other materials containing fluorine, many more industrial effluents may contain fluorides.

The extremely common form of pollution is due to the presence of proteins, fats, carbohydrates and other organic substances and materials found in industrial effluents. Among the trade wastes containing proteins are food processing and canning wastes, gelatine and size manufacturing wastes, slaughterhouse wastes, dairy wastes and tannery wastes.

Oil as a form of river pollution may come from barges, tankers, and boats on rivers or canals, or may be derived from industrial wastes, metallurgical industries, engineering works, garages, or indeed any trade premises using lubricating oils or fuel oils, the commonest of which are the fairly high boiling hydrocarbons oils derived from petroleum. Oil is most objectionable in a stream not only from an aesthetic stand point on account of the visible pollution it causes but also because it spreads to form a thin film on the surface and so trends to prevent diffusion of oxygen in to the water, thus interferring with reaeration of the river water.

Dyes in common use today are, with few exceptions, intensely coloured synthetic organic compounds capable of fixing them selves permanantly to various materials, i.e. not removed from washing. They are prepared for the most part from such coal-tarhydrocarbons as benzene, toluene, the xylene, naphthalene, anthracene etc. Dyes usually contain characteristic groups, chromphores, such as NO_2' azo, $N = N$-, and carbonyl which confer colour on molecule and in addition such as auxiliary groups as the sulforic acid, carboxyl, amino, dimethyl amino hydroxyl groups which aid in solubilizing the dye and assist in its attachment to the textile fibre. Dyes are usually present only in small amounts in textile waste water but may be objectionable on account of their colour.

Most of the references available in the literature regarding the researches on the river pollution belongs to pollution by fishes, by sewage, by industrial wastes and by others pollutants in India.

Several workers have reported their work on the different kind of industries, their effluents and many other factors related to the water pollution. Suckcharoen has studied accumulation in Ipomoea aquatica near a caustic soda factory in Thailand. The leaves and floating stems of Ipomoea aquatic a collected had accumulated 0.75-1.26 ppm mercury in floating stems. Leaves and floating stems from unpolluted areas had mercury contents much lower between 0.01-0.17 ppm and 0.01-0.06 ppm respectively. The fish from the polluted area were also polluted with mercury. This constituted a serious risk to water life as well as public health. Mercury pollution in Japan led to the most horrible infectious disease, Minemata. Maastik has studied probable pollution levels of natural waters from organic matter and fertilizers based on literature data. The average pollution levels of natural waters of two locations were studied and presented in the form of BOD_5, BOD_n, N and P_2O_5 indexes. The distribution in per cent of the probable pollution levels from different sources are given. The method described can be applied for compiling pollution balances for larger territorial units. The chemical oxygen demand and the total nitrogen and nitrate nitrogen concentration in potato processing plant waste water and in the soil solution at several

depths in a treatment field where the waste water was applied were studied by Smith for a period of two years. The chemical oxygen demand decreased, 95 to 99 per cent, from 2000 to 850 ppm in wastewater and to 40 to 4 ppm after passing through 150 cm of soil. A similar decrease in the total nitrogen concentration was found. The nitrate nitrogen concentration was also decreased.
The effect of the three anaerobic swine waste lagoons on ground water quality was investigated by Thomas etc. in the Atlantic coastal plain region. The lagoon studied were located on high water table soild with different textures. Ground water was sampled from wells, with unperforated casings located at depth to 6 meter and distance to 30 meter from the lagoons. The ground water contamination were density of fecal coliforms and concentration of cl, cu, Mn, NH_4^- *N,* NO_3^- *N,* PO_4^- *P and Zn. Chloride, ammonia-nitrogen and nitrate-nitrogen concentrations in ground water samplesindicated that seepage entered ground water from eabh of three lagoons. Rupture of lagoon seals leading to seepage was attributed to drying of exposed sub soild or embarkment soil during recession of lagoon liquid level and to gas release from nicrobial activity in soil beneath the seal.*

Bhaskaran, Chakarbarty and Trivedi studied the pollution in the river Gomti in different seasons. The water of river Gomti during its travel of 560 km. from Pilibhit to its confluence in Ganges at Saidpur in district Ghazipur received considerable pollution load from the communities and industries located on the bank of river. The pollution of the Gomti in the unknown region has increased considerably in recent years. They performed three stage studies i.e., (1) determining the extent of pollution of the water in the different seasons, (2) the capacity of the river Gomti to assimilate pollution, and (3) to work out suitable remedial measures for the abatement of pollution in the Lucknow region. The results of investigations were described in the paper. A thirteen miles stretch of river covering the city of Lucknow and Malhaur village was selected for survey. A survey was carried on daily volume of flow and the characteristics of the sewage and industrial wastes at the different out falls on the river with in the thirteen miles stretch in summer, (May to July). The results of the chemcial analysis of river water samples show that beyond sampling stations 5, the river is highly polluted during Feb. - July. The 5-days B.O.D. value of the river water which was of order 1.5 mg/l at the sampling station 1 increased 4 - 6 mg/l at the sampling station 6. High B.O.D. values persist throughout the entire stretch of the river surveyed.

A similar study on the Daha river in Bihar was carried out by Bhaskaran et. al. The river originates from sasamosa and flows in zig-zag manner over 120 km before meeting the river Gogra. In its course the river passes through Sasamosa town and 121 villages having the total population 1,50,000 before the establishment of the factories in the region the rural population used the water of Daha river for drinking, cooking, bathing and washing clothes. The river water also supported abundent fish life which was a cheap source of the animal protein to the population.

Since the setting up the sugar factories and distillaries along the river, it is being polluted by factory wastes, making it less useful to the population. There had been repeated demand from the people of this region, the mitigation of the pollution of Daha river. At the request of Bihar State Governement, a detailed survey was taken by the research unit of the All India Institute of Hygiene and Public Health, Calcutta during 1960-62 with a view to determine the extent of pollution of the river by factory wastes and to work out suitable remedial measures.

A preliminary survey of the entire course of the river was first carried out to locate the important source of pollution. The survey showed that the major source of organic pollution of the river was effluents from the sugar Mills and distillaries besides this, faecal pollution was also taking place through the sewage drains from the Siwan town and due to the indiscriminate defaecation on the river bank. Three sugar and one distillary mills discharge their waste water in to the river. Sugar mills discharge in

November to April and distillary throughout the year. Systematic observations on the quantity and quality of the different factory waste were carried out during 1960-62. The waste of Sasamosa increase the B.O.D. values up to 20,000 mg/l the total B.O.D. load discharged from this mill was 3,117 lb daily corresponding to a population equivalent of 18,702. From Siwan the B.O.D. load is 50 mg/l due to the low dilution available at this point. The total pollution load corresponding to the population equivalent of 14,970 was considered as very heavy. The Mir Ganj Sugar Mill discharge the maximum pollution load corresponding to the population equivalent to 75,864. The distillary discharge could not correctly be assessed because the flow was irregular.

The foregoing results showed that compared with the flow available in the river during the sugar season, the population load discharged in to the river by the factories is quite excessive, and practically converted the river in to the drain for carrying wastes in the summer months. For the collection of samples 20 stations were established covering the entire stretch of river. The points were chosen to give information of effect of waste discharge on the quality of river water. The B.O.D value was less than 3 mg/l throughout the year showing little pollution in the river up to the point of entry of first industrial first zone. The zone 2 is heavily polluted throughout the year except during the monsoon season. In zone 3, there is heavy pollution during January - March and moderate pollution during the rest of year. In zone 4, the pollution is very high.

Industrial waste has a direct impact on fish life. Carpenter was able to show that the death of fish in the polluted waters was due not to gritty material in suspension but to bad salts in solution. He was able to explain the nature of the toxic action of heavy metal salts on fish. It appears that the heavy metal ions (lead, zinc, copper, mercury, silver, nickel and cadmium) in dilute solution precipitate the mucous secretions produced by the gills; the interlameller spaces become filled with this precipitate and the normal movement of the gill filaments becomes impossible. The intimate contact between water and gill tisues which is necessary for respiration is thus prevented and eventually gaseous exchange is impeded to such an extent that the fish dies from asphyxiation.

Heavy metal salts in solution constitute a very serious form of pollution for they are stable compounds, not readily removed, and in soft waters are fatal to fish at very low concentrations. Copper salts are toxic to sticklebacks down to 0.02 mg/l. Mercury and silver salts are even more toxic, lead and zinc salts less so. Metallic pollution may persist for year after mining operations have ceased. Afleck has shown that zinc compounds are *highly toxic to the ova and alevins of rainbow trout. It is stated that as little as 0.01-0.02 mg/l may be fatal. Sticklebacks die in about 24 hours in a 1 mg. lead per litre solution of lead nitrate in soft water, but if 50 mg/l. of calcium is per sent, as chloride, nitrate or bicarbonate, they will live for about 10 days-the survival time of controls. All these substances kill fish by impairing the animals ability to obtain oxygen from the surrounding water.*

We may consider a very important pollutant which
~~Now~~ kills fish in an essentially different way. Hydrogen cyanide and soluble cyanides enter the body through the gills and the liming of the mouth, circulate in the blood stream and, by some specific inhibitory effect upon certain enzymatic oxidative processes, render the tissues more or less incapable of utilizing the oxygen brought to them.

Wells states that carbon monoxide may be present in effu-effluents from gas works and that it is highly toxic to fish. The extreme toxicity of this gas to man is well known, it is said to have an affinity for haemoglobin which is some 250 times that of oxygen and thus it can reduce enormously the oxygen-carrying power of the blood. The physiological effect of carbon dioxide on fish has been much studied but it is not well understood and the experimental results and conclusions of different inves-tigations are not in agreement. King found that concen-trations up to 200 p.p.m. had no apparent effect on trout.

There is, however evidence that in the presence of an abnormally high concentration of carbon dioxide the ability of fish to extract oxygen from the water, when the oxygen supply is limited, is appreciably impaired. Very different results were obtained with different fish.

In considering the oxygen requirments of fish the temperature factor is of great importance. Fish are poikilothermic and their metabolic rate increases rapidly with rising temperatures. Fish generally react to a deficient oxygen supply by breathing more rapidly, more regularly and more ever getically; in some cases only the rate of movement changes, in some cases only its amplitude.

Many workers have investigated the toxicity of ammonia and ammonium compounds to fish with varying results. It would seem that ammonia acts on fish as a true internal poison, entering the body via the gills and circulating in the blood stream, for its toxicity seems to be strictly corelatied with the permability of the gills for the toxic molecules. Stickle backs in ammonia solutions die suddenly with widely opened mouths and it has been noted that perch die with the gill covers raised.revealing the highly congested condition of the gills.

There remains a long catalogue of substances which occur in polluting effluents and whose effect on fish is not completely understood. Sodium hydroxide and other strong alkalis probably produce asphyxiation by coagulation of gill secretions. Aniline which may occur in effluents from gas works and dye works, is very toxic to fish which are at first stimulated and then intoxicated lying on their sides with their fins and gill covers moving feebly. Concentrations of free chlorine as low as 0.3 p.p.m. are said to be very toxic to trout. Ethyl alcohal, which may be present in fermentaing organic wastes, rapidly produces intoxication in fish. Phenol has an irritant action on mucous membranes and in sufficient quantities may provoke irritation and sloughing.

In summing up this review of fish toxicology it may be noted that their is fair amount of evidence suggesting that substances that are not ionized enter their bodies most readily. Fresh water fish normally swallow little or no water but have a dilute and copious urine. The amotic pressure of their body fluds is much higher than that of the surrounding medium so that considerable quantities of water pass in, mainly through the gills, for the scale covered integument is relatively impermeable. In this way the entraince of toxic substances may be facilitated and as the blood circulation of a fish is so arranged that blood leaving the gills is immediately delivered by the dorsal arota to all parts of the body it is not surprising that they can produce their effects so rapidly.

Fish exhibit a considerable degree of individual variation in resistance to toxic substances. Even if specimens of the same sex and size are selected for experiment there may be considerable differences in individual survival times.

The effects of three pollutants, lead, nickel and pentachlorophenol on the respiratory function of fish have been carried out by whitly and sikora. Nickel is effective but they observed that chlorophenol and bad inhibit respiration but nickel does not effect to this extent. The effect of bad is probabely due to mucous coagulation on the body wall inhibiting gaseaus exchange. Bryan detected the presence of lead in urban drainage samples which indicated the evidence of toxicity on the basis of biochemical oxygen demand in some smaples.

Ishida and Katayama have reported pollution by antimony from the Hilino Smelting works in shiga, Japan. The soil and the plants around contained 380 ppm antimony and the Amano river water, into which the factory effluent was dumped, contained 0.05 ppm antimony. Bacci etc. have reported the mercury decontamination in a river of Mount Amiata.

Sludge from industrial town generally contains varying proportions of trade wastes from industrial premises. Since the passing of the Public Health Act, 1937, most industrial towns have accepted increasing volumes of trade wastes into the sewers. But the local authorities may refuse to admit certain harmful wastes and may require the trader to carryout certain pre-treatment to prevent damage to the sewerage system. Many authorities now refuse to admit to their sewers trade wastes containing sulphides since they have been fatalities to men working in the sewers due to the evolution of poisnous hydrogen sulphide by interaction of the sulphides and acidic wastes. Many of the important sewage treatment processes make use of bacterial action so care must be taken to see that the concentration of toxic substances not so high as to involve any marked interference with bacterial activity. For instance, electroplating wastes may contain such bacterial poison as copper, chromate, cadmium, nickel and cyanides; most of these substances cause interference with sewage treatment processes when present in sewage to the extent of about 1-2 p.p.m.

In order to alleviate or prevent pollution of our rivers, it is necessary to provide means for the disposal and treatment of trade waste waters. The sue of the municipal sewers for this purpose is often the best method if a conveniently cited sewer is available and if the local sewage disposal works is large enough to cope with the wastes, is not already overloaded, and not adversely *affected by the wastes.*

If disposal to the sewers of local authorities is not feasible, or practicable, then a special treatment plant must be provided but, in general, it is not yet possible to purify every trade waste to the same high standard as is attained by treatment of sewage. Complete or even nearly complete elimination of polluting matter from most trade wastes is often difficult or expensive to achieve and it is usually necessary to be satisfied with only partial removal of the pollutants. Even if 100 per cent purification could be achieved, the cost would in most cases be quite prohibitive, for some trade wastes there is no satisfaction and economic method of treatment at all. Neverthless, new scientific discoveries can alter the situation considerably and the solution of many difficult trade waste problems probabely only awaits intensive research work by the industries or by a well-equipped organization. As, cyanide waste waters, as a result of recent investigations, can be oxidized by chlorination in alkaline solution to yield an effluent safe to discharge to a fishing stream.

Much population can often be abated at the source by making various processes and other charges, re-use of certain waste-liquors, recovery of by-products and by careful chemical control of the processes. Thus in some cases (e.g. coal washery effluents, and back waterfrom paper mills), the effluents can be treated and reused in a closed cycle so that there should be no discharge to the stream. It is some times advantageous to segregate certain wastes to facilitate treatment or disposal. Thus chromate wastes should be kept separate from cyanide wastes at a plating works since the former are treated by a reduction process and the later by an oxidation process.

The methods used for the treatment of trade wastes fall into three main classes, namely physical, chemical, and biólogical. In some cases, a physical method will produce a satisfactory effluent, for instance the use of sedimentation to remove suspended solide from wastes containing mineral matter in suspension. Where physical methods may be desirable, for instance, in the treatment of many textile wastes by floculation, with chemicals followed by sedimentation in tanks. Sometimes, biological methods may be required in addition to physical and chemical wastes, as in the treatment of viscose rayon wastes. However, satisfactory the methods of treatment of industrial wastewaters, it must be stressed that the careful management of the treatment plant is of paramount importance, for even the best-designed and most expansive plant can not be expected to function properly if misused, or carelessly run, or if the necessary skilled supervision is lacking.

Sundarasan reported the natural purification of a polluted stream is accomplished gradually the offensive nature of putrecible organic matter discharged in to a stream is diminished by depression and dilution, suspended matter is carried out the river or settles in the bottom by sedimentation, depending upon the hydrography of a stream. In addition to dilution and sedimentation, oxidizing organism chemical reaction entry of atmospheric oxygen in water, sterilizing effect of sun light and photo syntheitc process of chlorophyll bearing organism have their role in slef purification of water in a stream.

Dissolved oxygen and biochemical oxygen demand are two of the most important parameters in determining the effects of pollution and self purification when polluted water is exposed to air, oxygen from air is absorbed to supply the biochemical oxygen demand of the organisms thus deoxygenation and reoxygenation take place simultaneously. The amount of dissolve oxygen present at any instant can be determined by assessing the combined rates of deoxygenation and reoxyganation. Under their combined influences the exact course of the oxygen assests of a stream can be formulated. The curve obtained known as 'Sag curve' is represented, by the relationship given by Thomas as

$$D = \frac{K_1 \; L_a}{K_2 - K_1 - K_3} \quad 10^{-(K_1+K_2)\; t} - 10^{-K_2 t} + D_a \; 10^{-K_2 t}$$

where D is the dissolve oxygen saturation deficit at time t in p.p.m., t the average time of flow in day, D_a the initial oxygen saturation deficit in p.p.m., L_a the initial first stage B.O.D. in p.p.m., K_1 the deoxygenation constant per day, K_2 the reaction constant per day, K_3 the B.O.D. deposition constant per day.

In order to evaluate the capacity constants of the Adyar, river, Madras, observations were carried out by the author on a stretch of about 8¼ miles of the river from May to October in 1957. The entire length selected for study was surveyed and a longitudinal section of the river obtained cross-section sounding were taken at the three ganging stations and beach marks established to measure the flow in the river.

The Adyar river has a catchment area of about 200 sq. miles in a total run of about 25 miles before joining the bay of Bengal, it runs with in the southern limits of the Madras city. Different types of pollution and points of entry in to the river were observed along the stretch of the river and accordingly stations were established.

The sources and points of entry of the pollution were, raw sewage from residential area and wash refuse from the slaughter house in west Saidpur near station 3, septic tank effluents from King institute, partially treated sewage from the engineering college campus, separate samples were collected for chemical, bacteriological and biological analyses. Detailed chemical analysis was carried out at monthly interval in all the stations, but the determination of B.O.D. and D.O. values for the samples collected from all the stations were taken.

Studies on the characteristics and disposal problems of industrial effluents have been reported by Dalela et.al. The industries like textiles mills, fertilizer and antibiotic factories, slaughter houses and breweries have been studied on their disposal problems with reference to Indian standard Institute. All these industries discharge their effluents untreated or undiluted in different media such as land, in sewage, streams or in rivers. It was observed that the effluent discharged in these media contain high amount of total solids, suspended solids, dissolve solids, votatile solids, either highly acidic or alkaline and higher conductance values along with the high load of B.O.D. and low dissolved oxygen in comparison to the standards suggested by ISI and produce the abnoxious conditions in the environment. It is suggested that there wastes should be treated or diluted before they are discharged either on land, in sewerage or in streams and ponds.

Sarkar and Krishnamoorthi studied the biological methods for monitoring water pollution. Pollution of water resources due to discharge of wastes both organic *and industrial imparis the water quality and is posing a threat on an international scale. Rapid reliable methods are required to detect and assess water pollution levels. The biota in an aquatic ecosystem posittively reflects the condition existing in the environment and the data can be utilized for bilogical monitoring of water pollution levels. With a view to arrive at a simple and precise method of indicating pollution, the work was carried out on several fresh water and polluted water sources in Nagpur. Each water source is classified based on the quality and quantity of fauna present along with comp-limentary chemical parameters. The observation in the field were confirmed in the laboratory by conducting autoecological experiments. The field data and laboratory data have been presented.*

The analysis of the quality and quantity of biota around Nagpur reveals that this system which was exten-sively used in central Europe can be very well utilized to classify the water bodies at Nagpur and other places in India.

River pollution by rayon mill has been reported by De and Mukherjee. The problem of pollution of Chambal River by the waste waters from the Gawalior Rayon Silk Manufacturing (Weaving) Co., Ltd., at Nagda in discussed. The data collected during the preliminary survey of the river are presented. The river has been found to be greatly polluted due to the discharge of untreated wastes from the rayon factory. The need for a detailed survey of river covering chemical and biological aspects of stream emphasized.

The data collected indicated clearly that Chambal River is polluted by the discharge of untreated wastes from the rayon factory. The pollution has rendered the river unfit for any benificial use. Before the establishment of the factory all varieties of fresh water fish were abundant in river. At present no fish exist in the stretch of river surveyed. There is also history of cattle death due to drinking of river water.

Rhine River pollution studies have been reported by cornelius Biemond. Rhine river has, in all historical times been an navigation channel of primary importance; it always connected many countries and nations.

Besides various studies on river pollution, there are so many references have been cited for the control of river pollution by treating industiral and sewage effluent before they are folw in to the stream.

Ghatpande et. al. researches on the spent wash from Government distillary at Chaitali. The waste product of alcohol factory called the 'spent wash' is reddish brown in color having characteristic unpleasant smell, low pH (4.5) and high B.O.D.(50,000 - 60,000 p.p.m.). It has *high total solids which do not easily part with the water and its disposal is very difficult. Experiments were conducted at Maharashtra Engineering Research Institute, Nasik on the spent wash. It was found that if the spent wash is treated with anaerobic digester first and then aerated in oxidation ditch, there is appreciable reduction in B.O.D. and increase in pH values.*

Lyengar and Gandhi also suggested the biological treatment of industrial waste by the oxidation ditches. They performed their work on pharmaceutical and chemical effluents. The first objective was choosen for the purpose of reducing the high B.O.D. load encountered to a level of 300 mg/litre.

Problem of pollution in waterways have been stated by Bishnoi. He made an attempt to summarize the major issues involved. The author has given details of some of the better known pollutants, their origin and characteristics, their action on receiving water, and alternative methods available to treat the wastes. Gupta described the water pollution control due to industrial wastes with the reference to Rourkela Steel Plant. The treatment plant renders the effluent with in the specifications prescribed by the Orissa River Board, i.e. 30 p.p.m. of suspended solids and 20 p.p.m. B.O.D. The inflow of tar, ammonia, benzols, etc. have posed certain problems for the operation and maintenance of the plant.

These difficulties have been overcome by construction of catch pits at various places and installing the ammonia still saturators etc.

Importance of water pollution control and its urgent need has been suggested by Radhakrishna. The ill-effects of pollution of water course by wastes are many and far reaching. It endangers the health of people. Water pollution by sewage is largely responsible for the high incidence of gastro intestinal diseases prevailing in the country. Poisonous substances discharged through industrial wastes make the water dangerous to human beings, animals and plants. Excessive pollution renders the water unsuitable for reuse as a source for community water supply as the cost of purification of such waters may be prohibitive. A part from damaging the health of people, water pollution renders the water less useful for irrigation, industries and for power development. The wastes have a deleterious effect on bridges,dams and boats. Water pollution also reduces the value of property adjoining polluted water course.

In comparison of industrialization the treatment of industrial wastes has been absent or haphazard. Urbanization of communities has been equally rapid; but the provisions of community water supplies and sewage facilities have not kept pace with needs.

AIM, SCOPE AND METHODCLCGY

Aim and Scope:-

The present study is intended to bring at one place in the form of annotations all the significant literature that is available in the field of river pollution caused by industrial waste. Although the bibliography is selective in nature, an attempt has been made to cover all the aspects of river pollution.

I am confident that this bibliography will be helpful to all those who have some interest in the field of water and river pollution due to industrial waste and its abadement. Mainly research scholars in this field will find it helpful.

Part I deals with definition, effect and abadement of river pollution. Part II which is the main part of present study consists of an annotated list of 252 documents.

Methodology:-

While embarking on this task a general survey of the literature available in impartant libraries viz. Maulana Azad Library, Z.H. Engineering College Library, Libraries of Chemistry & Botany Departments A.M.U., Aligarh was conducted. Out of a number of periodicals covering the field only important ones were selected for this purpose. A list of periodicals documented has been given at the end of Part I.

<u>Standards Followed</u>:-

As far as possible the Indian standards recommended for bibliographical references (IS : 2381-1963) have been followed.

After searching the literature entries were recorded on 5" X 3" cards. The entries in the bibliography contain abstracts giving essential information about the articles documented.

<u>Arrangement</u>:-

Efforts have been made to arrange the entries under Co-extensive subject headings and for this purpose a comprehensive list of subject heading was compiled. Although there is always scope for difference of opinion on any issue, the list of subject headings will generally be found following a logical helpful sequence.

Under the specific subject headings the entries have been made alphabetically by author. The entries are serially numbered.

<u>Indices</u>:

Part III of the bibliography contains Author, Subject and Title indices in separate alphabetical sequences. Each index guides to the specific entry or entries in the bibliography. I hope it will be found very useful in making use of the bibliography.

LIST OF PERIODICALS

S.NO. (1)	ABBREVIATION USED (2)	NAME OF THE PERIODICAL IN FULL (3)	FREQUENCY (4)	PLACE OF PUBLICATION (5)
1.	Acta Hydrochim Hydrobiol.	Acta Hydro Chimicaet Hydrobiologica	Bi-monthly	Leipzik (East Germany)
2.	Agric. Environ.	Agriculture and Environment	Quarterly	Amsterdam
3.	Appl. Environ. Microbiol.	Applied and Environmental Microbiology	Monthly	Washington
4.	Appl. Microbiol.	Applied Microbiology	Half Yearly	Sofia, Bulgaria
5.	Arogya	Arogya	----do------	Manipal
6.	Bull. Environ. Toxicol.	Bulletin of Environmental Contamination & Toxicology	Four monthly	New York
7.	Chem. Age India	Chemical Age of India	Monthly	Bombay
8.	Chem. Era	Chemical Era	Monthly	Calcutta
9.	Chem. Engng. Wld.	Chemical Engineering World	Monthly	Bombay
10.	Chem. Ind. Dev.	Chemical Industry Development	Monthly	Bombay

(1)	(2)	(3)	(4)	(5)
11.	Colourage	Colourage	Fortnightly	Bombay
12.	Current Science	Current Science	Monthly	Banglore
13.	Desalination	Desalination	18 per year	Amsterdam
14.	Environ. Pollution	Environmental Pollution	Monthly	Essex
15.	Environ. Sci. Technol.	Environmental Science and Technology	Monthly	Washington
16.	Fishery Technol.	Fishery Technology	Half Yearly	Cochin
17.	Ground Water	Ground Water	Bi-monthly	Worthington
18.	Hydrobiologia	Hydrobiologia	5 per year	Hague (Netherland)
19.	IAWPC Tech. Annual	Indian Association of Water Pollution Control (Technical Volume V)	Yearly	Nagpur

(1)	(2)	(3)	(4)	(5)
20.	IAWPC Conv. Vol.	Indian Association of Water Pollution Control (Convention Volume III)	Yearly	Nagpur
21.	Indian Chem. Mfr.	Indian Chemical Manufacture	Monthly	Bombay
22.	Indian J. Ecol.	Indian Journal of Ecology	Half Yearly	Ludhiana
23.	Indian J. Environ. Hlth.	Indian Journal of Environmental Health (Environmental Health during 1962-70)	Quarterly	Nagpur
24.	Indian J. Exp. Biol.	Indian Journal of Experimental Biology	Bi-monthly (Quarterly during Jan.63-Oct.1971.)	New Delhi
25.	Indian J. Fish	Indian Journal of Fisheries	Half Yearly	Cochin
26.	Ind. J. Mar. Sci.	Indian Journal of Marine Science	----do----	New Delhi
27.	Ind. J. Med. Res.	Indian Journal of Medical Research	---do----	Bombay

(1)	(2)	(3)	(4)	(5)
28.	Indian Sug.	Indian Sugar	Monthly	New Delhi
29.	J. Indian Chem. Soc.	Journal Indian Chemical Society (Presently Indian Chemical Society Journal)	Bi-monthly	Calcutta
30.	J. Instn. Engrs. India	Journal of Institution of Engineers, India	Four monthly	Calcutta
31.	J. Scient. Ind. Res.	Journal of Scientific and Industrial Research	Monthly	New Delhi
32.	Jour. Water Poll. Control Fed.	Journal of Water Pollution Control Fedration	Monthly	Washington
33.	Leath. Sci.	Leather Science	Monthly	Madras
34.	Mahasagar	Mahasagar	Quarterly	Panaji, Goa
35.	Proc. a Conv. Sugar Technol. Ass. India	Proceedings Convention Sugar Technologists Association of India	Yearly	Kanpur

(1)	(2)	(3)	(4)	(5)
36.	Proc. Ind. Acad. Sci.	Proceedings Indian Academy of Science	Monthly (Quarterly since 1978)	Banglore
37.	Proc. Ind. Waste Conf.	Proceedings Industrial Waste Water Conference	Bi-monthly	Chicago
38.	Science & Culture	Science and Culture	Monthly	Calcutta
39.	Science & Environment	Science and Environment	Half yearly	Aligarh
40.	Sew. & Ind. Waste	Sewage and Industrial Waste (Formerly Sewage Works Journal)	Monthly	Washington
41.	Sirpur Industries Journal	Sirpur Industries Journal (Presently Indian Pulp & Paper Technical Association)	Irregular	Saharanpur
42.	Tanner	Tanner	Monthly	Banglore
43.	Technology, Sindri	Technology Sindri (Formerly Fertilizer Technology)	Quarterly	Sindri, Dhanbad
44.	Water, Air, Soil Pollution	Water, Air,& Soil Pollution	8 per year	Dordrecht(Netherland,
45.	Water Sewage Works	Water and Sewage Works	Monthly	Chicago
46.	Newsl. Zoo. Surv. India	Zoological Survey of India News letter 1975	-	Calcutta

PART II

3. PATIL (MD) etc. A presumptive synthetic medium for the enumeration of Coliforms in Water. Indian J. Environ. Hlth. 19, 1; 1977; 1-15.

A synthetic medium for the presumptive enumeration of Coliforms in Water has been developed using ammonium salts as the main source of niterogen. Waters of different pollutional loads from various sources have been tested and the data obtained are statistically evaluated and presented in this paper. The cost comes out to be Rs.100/- for 100 liters of the medium.

4. SENGUPTA (R) and SANKARANARAYANAN (VN). Pollution studies offf Bombay. Mahasager. 7, 1-2; 1974; 73-8.

Studies on the biological oxygen dem and (BOD_5) in the near shore waters off Bombay indicate a rate of discharge of Sewage of about 2000 X 10^6 m^3 per year. From the hydrographical data it is concluded that if a Submarine pipline is proposed to be laid for the discharge of Sewage into sea, the ideal site would be at a distance of 25-30 Km. off the northern part of the city at a depth of about 15-20 m. A comparison with Chemical observations made 15 years ago for the same area showed that an increase in organic phosphate in the inshore waters off Bombay has defintitely occured during the last 15 years.

INDUSTRIAL WASTE, WATER POLLUTION, HUSAIN SAGAR.

5. AZIZ HUSSAIN (M). Preliminary observation on pollution of Hussain Sagar caused by industrial effluents. Indian J. Environ. Hlth. 18, 3; 1976; 227-32.

A case of heavy fish mortality in the lake Hussain Sagar Hydrabad, Andhra Pradesh on 6th & 7th May 1975 due to discharge of effluent without being properly diluted and treated by near by factories has been observed. The

The either effect on fishes was found to be enhanced by the combined toxic concentration of (i) Free CO_2 (ii) H_2S (iii) Oxidisable Organic matter (iv) Nitrogen complexes (v) a large amount of solids and (vi) an accute depletion of Oxygen Concentration.

INDUSTRIAL WASTE, WATER POLLUTION, EFFECTS, FISHLITE.

6. *MUTHUSWAMY (S) etc. Fish polyculture in Sewage effluent Ponds. Indian J. Environ. Hlth. 20, 3; 1978; 219-31.*

This paper is based on studies conducted in three oxidation ponds connected in series at the sewage treatment plant of the College of Engineering, Guindy to estimate the algal fish biomass productivity and to observe the growth pattern of fish in a pond system containing polyculture. It was observed that the rate of survival of fish was very high and fish yield is also considerably higher than reported elsewhere.

INDUSTRIAL WASTE, AMINOACIDS, RIVER POLLUTION.

7. *SASTRY (CA). Removal of aminoacids from sewage by activated sludge. Envir. Hlth. 7, 3; 1965; 111-5.*

Amino acids both in free and combined form are rapidly removed from sewage by activated sludge process. The rapidity of removal of aminoacids is dependent upon the concn. of sludge and the period of aeration. During the activated sludge process, the removal of combined amino acids from sewage closely follows the purification and the removal of phosphorous.

INDUSTRIAL WASTE, AMMONIUM NITROGEN, RIVER POLLUTION.

8. *BHATTACHARYA (GS) etc. Investigation into the use of algae for removing ammonium nitrogen from nitrogenous industrial wastes. I. Laboratory batch studies. Technology, Sindri. 3, 3; 1966; 135-48.*

The use of algae for removing ammonium N from nitrogenous industrial wastes containing many times more N than sewage, has been studied in the Lab. using Synthetic effluents without controlling temp., incident day light intensity and pure culture conditions, thus simulating out door envir. conditions. These investigations have shown that wherever high ammonium N is the Chief polluting constituent in an effluent biological treatment by algae might be the answer.

9. *BHATTACHARYYA (GS) etc. Investigation into the use of algae for removing ammonium nitrogen from nitrogenous industrial wastes. II. Semi-continous laboratory studues. Technology, Sindri. 5, 1; 1968; 31-7.*

Studies were made with semi-continous cultures using the Synthetic nitrogenous waste water and the same strain of chlorella pyrenoidosa as in the batch expt. Algal growth rate and rate of ammonium nitrogen utilization increased about two-fold over the same in the batch studies.

INDUSTRIAL WASTE, AMOEBIC CYSTS, RIVER POLLUTION.

10. *PANICKAR (RVRC) etc. Destruction of Entamoeba histolytica cysts during emergency disinfection. Envir. Hlth. 9, 2; 1967; 172-6.*

4% sterile sewage, artificially contaminated with amoebic cysts in a concentration of 30 cysts/ml was used.

Globaline tablet and iodine were more efficient than the other two and could kill the amoebic cyts within 5 min. with the above doses, even at a temp. as low as 10°C within a pH range of 6.5 to 8.5. The cysticidal efficiency of Chlorine and halazone were found to depend much on the variations in pH, temp. and contact time.

INDUSTRIAL WASTE, ANTIBIOTICS, RIVER POLLUTION.

MUDRI

11. ~~Mudri~~ (SS) and PHADKE (NS). Characteristics of antibiotics wastes. Envir. Hlth. 10, 1; 1968; 40-2.

This study on the characterisation of wastes from a factory producing penicillin and streptomycin shows that these are strong wastes as compared to domestic sewage. They have a high content of total solids of which nearly 40% is volatile. The wastes have a high content of easily degradable organic matter as indicated by the BOD test.

INDUSTRIAL WASTE, BACTERIA, RIVER POLLUTION.

12. RAO (NU) and PARHAD (NM). Quantitative studies on the bacterial pollution of lake and river water. Envir. Hlth. 9, 2; 1967; 93-102.

Weekly bacteriological analyses were carried out on waters of Ambazari and Gorewara lakes and kanhan river. Coliforms, E. Coli and Enterococci were estimated. A definite seasonal variation in the number of these 3 groups of organisms was seen and they occured in larger numbers during rainy season than in winter and summer months.

INDUSTRIAL WASTE, BIOCIDES, RIVER POLLUTION.

13. *KOUNDINYA (P Ranganatha) and RAMAMURTHI (R). Tissue respiration in Tilapia Mossambica exposed to lethal concentration of Sumithion and Sevin. Indian J. Environ. Hlth. 20, 4; 1978; 426-8.*

Indiscriminate use of biocides for crop protection some times cause much havoc to fish and other aquatic fauna. Continued presence of these chemical in irrigation canals both in small and large amounts produce various physiological changes in aquatic animals. The experimental results suggests that exposure of Sumithion and Sevin causes metabolic depression. Experiments aimed at understanding the mechanisms underlying metabolic inhibition in fish are in progress.

14. *VERMA (SR) etc. Bioassay trials of organic Biocides on fresh water fish. Indian J. Environ. Hlth. 19, 2; 1977; 107-115.*

Biocides like aldrin, enderin, B.H.c. Chlorodane, ekatin etc. are widely used for controlling insect pests of agricultural fields in India. Studies of static bioassaywith these biocides on fresh water fish, Labeorohta, show that chlorodane is most toxic and Sumithion least toxic to the test fish. Organochlorines are most toxic than organophosphates biocides.

15. *VERMA (SR) etc. Quantitative estimation of Biocides residues in few tissues of Labeo Rohita and Fossilis. Indian J. Environ. Hlth. 19, 3; 1977; 189-98.*

The three biocides-chloradane, metasystox and sevin were found to accumulate to the maximum extent in the gills and to the minimum in the intestine. In the

18. DEWLING (RT) etc. *Effect of Seasonal effluent chlorination on coli forms in Jamaica Bay.* <u>Jour. Water Poll.</u> Control Fed. 42, 7; 1970; 1351-61.

A study of the effect of waste water post-chlorination on receiving water quality was conducted at Jamaica Bay, a Shallow tidal estuary in New York City. The data collected showed a significant decrease in coliforms after start-up of chlorination and an increase in coliform counts after cessation of chlorination. Post chlorination seems to be an effective means for reducing water coliform-populations.

19. SHARMA (AK) and VENKOBACHAR (C). *Effect of Prechlorination on Coagulation of Algae.* <u>Indian J. Environ. Hlth</u>. 21, 1; 1979; 16-22.

The aim of this study was to evaluate the effect of prechlorination in the improvement of algal removal by alum coagulation and flocculation. The studies indicate that chlorination can be adopted before alum coagulation and flocculation particularly for high pH waters to improve algal removal efficiency where alum alone is ineffective.

20. THATCHER (TO). *The relative sensitivity of Pacific Northwest fishes and invertebrates to chlorinated sea water.* <u>Envir. Impact Health Eff., Proc. Conf</u>. 2, 1978; 341-50.

The toxicities of chlorinated seawater to 8 fish and 7 invertebrates species was detected by 96-h LC 50 continous flow bioassays. A thermal stress was included to more closely simulate power plant cooling water effluents. Concns. curves were parallel for all tested species indicating that they would show the same order of sensitivity at high and low concns. This also suggests that the same mechanism of toxicity was responsible for the mostality of these fish and invertebrates.

liver, kidney and muscles the accumulation was found to be in between these two extremes. The two species of fresh water fish used for the study were Labeo Rohita and Saccobranchus fossilis and the accumulation of biocides was found to be higher in the former that in the latter.

INDUSTRIAL WASTE, CARPROLACTUM, RUVER POLLUTION.

16. *PATEL (MD) and PATEL (DR). Biodegradability of caprolactam waste. Indian J. Environ. Hlth. 19, 4; 1977; 310-8.*

A two stage aeration system and oxidation ditch can effectively be used for the treatment of carprolactum wastes which are obtained from a carprolactum plant producing carprolactum, the monomer for Nylon 6, according to this study.

INDUSTRIAL WASTE, CHLORINE, RIVER POLLUTION.

17. *BANERJEA (S) etc. A case of heavy fish mortality in the river at Dehrion Sone, Bihar caused by the wastes of the Rohtas Industries Ltd. Dalmianagar. Indian J. Fish. 3, 1; 1956; 186-96.*

A case of heavy mortality in the river Sone, due to the discharge of toxic effluents by the Rohtas industtries Ltd., has been studied. It has been observed, also, that owing to low Oxygen concentration, the mortality still continued even when the chlorine was present in sub-lethal concentrations. It has been shown that this heavy mortality of fish by Chlorine toxicity can be prevented by adjusting the rate of flow of toxic effluent in the main factory drain.

21. ZILLICH (JA). Toxicity of combined chlorine residuals to fresh water fish. Jour. Water Poll. Control Fed. 44, 2; 1972; 212-20.

On site continous flow bioassays on fathed minnows using chlorinated and dechlorinated effluents from two treatment plants have shown residual chlorine to be the principal toxic agent in these effluents. The toxic effects at both the locations were similar inspite of the fact that one plant received metal-finishing wastes and the other did not; in both cases, the pH and dissolved oxygen concentration were favourable for fish life. The addition of sodiumthiosulphate to both effluents removed the residual chlorine and rendered them non toxic.

INDUSTRIAL WASTE, CHROMIUM, RIVER POLLUTION.

22. BHARTI (A) etc. Psychological imbalance bue to chromium^{+6} in fresh water algae. Indian J. Environ. Hlth. 21, 3; 1979; 234-43.

The study describes the physiological response due to hexavalent chromium on three test alga; ulotheix fibriate, cladophora glomerata and stigeoclonium tenue studies showed that the growth of u.fimbriata is inhibited at 0.15 ppm of Cr^{+6}. As regards C. glomerata and s.tenue the growth lasts upto 025 ppm. The sensitivity of u.fimbriata and C. glomerata was found to be inversely proportional to the increase in ionic strength of test substrate while the reverse is true in case of S. tenue.

23. KU (FH) etc. Scavanging of chromium and cadmium by aquifer material south Farming date. Massapequearea, Long Island, New York. Ground Water. 16, 2; 1978; 112-8.

A plume of ground water enriched by liq.metal plating effluent has formed down gradient from an industrial *park in the title area. Discharges from the plant to the shallow aquifer began in 1942 and continous to the present. Cr & Cd in the core sample of aquifer material from the plume were analyzed by oxalate extension and dithionite-citrate-bicarbonate extn. method; the median concns. of extd. Cr and Cd in the aquifer material are 7.5 and 1.1 mg/Kg soil respectively and the max. concns. are 19 and 2.3 mg/Kg respectively.*

<u>INDUSTRIAL WASTE, COALWASHERY, RIVE POLLUTION</u>.

24\. *RAO (MN) and SASTRY (CA). Treatment of coal washery wastes by coagulation. <u>Envir.Hlth</u>. 10, 4; 1968; 265-76.*

Nirmali Seed (Strychnos potatorum) an indigenous source of polyelectrolyte, was very effective in coagulating coal particles from washery wastes. The dose of Nirmali Seed required, dependend upon the initial suspended solids content of the waste. Alum alone or alum aided by Nirmali Seed was very effective in removing suspended solids from washery wastes. Starch and caustic starch were not effective in removing coal particles from washery wastes.

<u>INDUSTRIAL WASTE, COPPER-SILVER IONS, RIVER POLLUTION</u>.

25\. *YOUNG (RG) and LISK (DJ). Effect of copper and silver ions on Algae. <u>Jour. Water Poll. Control Fed</u>. 44, 8; 1972; 1643-7.*

A comparison of growth inhibition of several species of green and blue-green algae by copper ions and mixture of copper and silver ions was made. Cell multiplication was assessed by optical density readings or by cell weight. The copper silver mixture was usually slightly more effective than copper alone. The added cost and potentially greater toxicity to fish of the silver *containing mixture makes it of doubtful practical value.*

INDUSTRIAL WASTE, CYANIDES, RIVER POLLUTION.

26. *DOUDOROFF (P). **Some experiemts on the toxicity of complex cyanides to fish.** Sew. & Ind. Waste. 28, 8; 1956; 1020-40.*

The toxicity to minnows, Pimephalespromelas, of mixed solns. of sodium cyanide and sulphates of heavy metals, diluted usually with synthetic soft water, was evaluated. These and other tests were performed in order to learn how dangerous to fish are some of the complex cyanides found in industrial wastes. The potentialities of complex formation as a waste treatment method thus were explored also.

27. *GANDHI (PG) and VARDE (RS). Cyanide waste disposal. Envir. Hlth. 7, 4; 1965; 226-34.*

Alkaline chlorination with bleaching powder was tried for the destruction of cyanide. Cyanide to chlorine ratio of 1:3.4 was found to be optimum. Bio-assay studies were also made to evaluate the effect of residual cyanide on fish.

INDUSTRIAL WASTE, ENDOSULFAN, RIVER POLLUTION.

28. *GREVE (PA) and WIT (SL). Endosulfan in the Rhine river. Jour. Water Poll. Control Fed. 43, 12; 1971; 2338-48.*

Endosulfan proved to be cause of a massive fish kill in the Rhine river in June 1969. Its fate was studied for *the rate of detoxification. Degradation was induced by bacteria under neutral, aerobic conditions. Endosulfan was found to be adsorbed by river silt, and upto 85% was removeable by filtration and centrifugation. Other adsorbents found useful were ferric hydroxidegel and activated carbon.*

INDUSTRIAL WASTE, ETHYL PARATHION, RIVER POLLUTION.

29. *SRIVASTAVA (GN) etc. Effect of sub-lethal Ethyl Parathion on the Metabolism and activity of Colisa Fasciata (Bloch Schneider). Indian J. Environ. Hlth. 19, 1; 1977; 63-6.*

Observations on the effect of sub-lethal ethyl parathion on activity and metabolic rate of the fish Colisa fasciata (Bloch and Schneider) at 20°C and 30°C have been made. The values of standard metabolic rate ranged from 68.8 mg/kg/hr 20°C and 202.0 to 366.5 mg/kg/hr at 30°C under various experimental conditions. The relative shift in the metabolic rate at 30°C ranged from 1.66 to 2.96 under various experimental conditions when compared to that at 20°C.

INDUSTRAIL WASTE, FERTILIZER NITROGEN, RIVER POLLUTION.

30. *BIJAYSINGH etc. A rational approach for optimizing application rates of fertilizer nitrogen to reduce potential nitrate pollution of natural waters. Agric. Environ. 4, 1; 1978; 57-64.*

In fertilizer experiments with wheat and corn in N-P-K rates were 0, 50, 100 & 150% the greatest NO_3^- accumulation was nearly 40 mg NO_3^-/Kg at 30-45 cm. depth in the case of corn receiving 150% N-P-K. If 60 kg N/ha of the applied N was considered to be a permissible residual level which did not pose a pollution threat, the optimum *rates of fertilizer N for wheat and corn were 186 and 111 Kg/ha respectively.*

INDUSTRIAL WASTE, FLUORIDE, RIVER POLLUTION.

31. *NAWLAKHE (WG) and BULUSU (KR). Effect of various parameters in the removal of fluorida by Nalgonda technique. Indian J. Environ Hlth. 20, 2; 1978; 156-9.*

The paper describes the effects of various parameters viz. polyphosphates, nitrates, silicate, organic matter and temperature on the removal of fluoride by the Nalgonda technique. The study showed that polyphosphates, niterate and organic matter donot have an adverse effect on this technique. It was found that silicate and temperature affect defluoridation adversely.

32. *SETH (GK). Application of activated corbon in water treatment processes. Environ Hlth. 7,1; 1965; 44-6.*

The importance of application of activated carbons in water treatment processes such as taste and odour removal,and colour and flouride removal, etc. has been discussed. Inspite of the definite advantages of these carbons in water treatment processes, their use in removal of some objectionable characteristics of water like taste and odous, colour and fluorides, has certain limitations. Experimental data on the use of these activated carbons for fluoride removal has been presented.

33. *THERGAONKAR (VP) and NAWLAKHE (WG). Activated magnesia for flouride removal. Indian J. Environ. Hlth. 13,3; 1971; 241-3.*

Magnesia reduces the fluoride concentration significantly. The dose required, is however high. The pH of treated *water is above 9.0. Even a dose of 1500 mg/l of magnesia does not bring down the fluoride to less than 1.2 mg/l when the initial fluoride concn. is more than 5 mg/l F.*

INDUSTRIAL WASTE, FLY-ASH, WATER POLLUTION.

34. *BHARATHI RAMANATHAN (M) and RAMARAO (KV). Fly-ash pollution along the Ennore coast (Madras, India). Newsl. Zoo. Surv. India. 2,5; 1976; 180-2.*

The effect of fly-ash on the marine life is discussed. The restriction on discharge of fly-ash into the sea along the Ennore coast by the Ennore Thermal station (13 Km. north of Madras) has been recommended to prevent adverse effects on the living resources of Ennore Waters. Installation of cement plants which can utilise fly-ash adjacent to thermal stations is one method of preventing the pollution of Ennore Coast.

35. *KHANNA (P) and MALHOTRA (SK). Kinetics and mechanism of Phenol Adsorption of fly-ash. Indian J. Environ. Hlth. 19. 3; 1977; 224-37.*

This study deals with the kinectics and mechonics of phenol adsorption wing flyash and provides interesting data in the design of economical and flexible phenol-flyash adsorption systems. High Cost and difficult procurement of activated carbon in India has prompted search for suitable alternatives. Flyash, a waste product of thermal power industry has large specific surface and consists of oxides of silica, aluminium and iron, with some unburnt carbon.

INDUSTRIAL WASTE, HEAVYMETALS, RIVER POLLUTION.

36. Mc VAUGH (Jack) and WALL (William T Jr.). Optimization of heavy metals waste water treatment: Effluent quality versus sludge treatment. Proc. Ind. Waste Conf. 31; 1977; 17-25.

An optimization study was conducted at a pretreatment facility which normally accomplishes more than 20% removal of suspended solids total Cr, Fe, Pb and Zn which have average influent concentrations of 200, 26, 56, 8.9 and 42 mg/L respectively. The system is based on a flocculator-classifier which uses lime and poly-electrolyte as coagulants. The principal operating parameters varied were the process pH and the sludge recycle rate. The highest process pH level tested 10.5 produced the lowest effluent suspended solids and heavy metals concentrations, provided the greatest system stability and improved the gravity thickness ability to handle solids. The plant is now being operated with a process pH of 10.2.

37. SANKARANARAYANAN (VN) etc. Concentration of some of the heavy metals in the oyster, crassostrea madrasensis (Preston) from the Cochin region. Ind. J. mar. Sci. 7, 2; 1978; 130-1.

High concentrations of zinc, copper and Iron (Fe) were observed in crassostrea madrasensis collected from the Cochin backwaters. High concentrations were observed during Dec. to May. Low values were observed from June to November, when the fresh water discharge through the rivers was maximum. The high levels of these metals were considered to be due to industrial and domestic pollution.

INDUSTRIAL WASTE, HERBICIDES, RIVER POLLUTION.

38. SANDERS (HO). Toxicities of some Herbicides to six species of fresh water crustaceans. Jour. Water Poll. Control Fed. 42, 8(pt 1); 1970; 1544-50.

The 37 herbicides not only differ greatly intoxicity but also exhibit large variations in sensitivity among the six species. The toxicities of different formulations of the same herbicide also differ greatly. Dichlone was the most toxic herbicide tested. Herbicides were generallymost toxic to daphnia, following in descending order of sensitivity were seed shrimp, glass shrimp, sowbug, scud and cray fish.

INDUSTRIAL WASTS, HYDROGEN SULPHIDE, RIVER POLLUTION.

39. PANDIT (RK). Removal of hydrogen sulphide from sewage sludge gas. Indian J. Envtron. Hlth. 13, 4; 1971; 307-15.

An early and economical method of scrubbing the gas with the effluents for removal of H2S is reported and compared with other two methods. It could remove 36 to 60 instead of less than 15 grains by other methods when H2S content of the raw gas ranged from 600-1300 gr/100 cuft/cuft of scrubbing liquid used.

INDUSTRIAL WASTE, INSECTICIDES, RIVER POLLUTION.

40. BASAK (PK) and KONAR (SK). A new method for determination of safe concentrations of insecticides to protect fishes. Indian J. Environ. Hlth. 19, 4; 1977; 283-92.

The paper describes the development of a new method for the determination of safe concentrations of an insecticide with a view to protect fishes. The chlorinated hydrocarbon, thiodan was tested on three species of fish, carp, cyprinus carpio, singhi, Heteropneustes fosislis and tilapia, Tilapila mossambica. Tests were conducted in the laboratory at 20-25°C and in out door at 21-28°C to evaluate the safety of the estimated levels. At these levels, fish showed normal feeding behaviour, growth and reproduction.

41. VISWESWARIAH (K) etc. Wood Charcoal as a decontaminating agent for the removal of Insecticides in Water. Indian J. Environ. Hlth. 19, 1; 1977; 30-7.

The production of incesticides and their use in agriculture, public health and forestry result in the contamination of soils, water and vegetation. A few harmless economical and inert adsorbents are screened to decontaminate water both from organophosphorus and organochlorine insecticides. Among the different adsorbents screened, wood charcoal powder 35/40 mesh size at 4% level could remove BHC, DDT, lindane and at 5% level fenitrothion, parathion and cidial. Malathion was removed to about 60%. Since the material is readily available, cheap and harmless, it can be used to purify insecticide contaminated water for drinking purposes.

INDUSTRIAL WASTE, IRON, RIVER POLLUTION.

42. DIXIT (RC). Iron in kumili water-problems, investigations and solution. J. Instn. Engrs India. 56, 1; 1975; 8-11.

A treatment scheme consisting of purification by aeration, alkali addition, disinfection and the filtration has been proposed for the removal of iron from the water.

43. RAY (P) and DAVID (A). A case of fish mortality caused by precipitation of ferric iron in the river Daha at Siwan (N. Bihar). Indian J. Fish. 9,1; 1962; 117-22.

A case of fish mortality caused by the precipitation of ferric iron in the water Daha polluted by sugar and distillary wastes at Siwan (North Bihar) was studied. Fine suspended matters like ferric hydroxide which coated the gills, in presence of fairly high dilution of toxic substances, such as carbon dioxide in the presence of low dissolved oxygen concentration appeared to accelerate the distress of the fish particularly of samll-sized weed fishes and minnous.

INDUSTRIAL WASTE, KAOLINE, RIVER POLLUTION.

44. NARASIAH (KS) and SOUCY (A). Coagulation of kaoline suspensions using magnetic treatment. Indian J. Envtron. Hlth. 13, 3; 1971; 211-9.

Studies were conducted under known conditions of pH, temp. and Zeta-potential as well as coagulant dosage. The size of the floe in case of the magnetic treated suspension was found to be bigger than that of the non-treated. The strength of the flock was found greater in case of magnetic treated sample than its counter part. Slight increase of 0.05 to 0.10 in the pH value of the treated sample was observed.

INDUSTRIAL WASTS, LIMULUS LYSATE, RIVER POLLUTION.

45. EVANS (TM) etc. Rapid determination of bacteriological water quality by using Limulus lysate. Appl. Envtron. Microbiol. 35,2; 1978; 376-82.

The Limulus lysate assay was used to measure the endotoxin content in stream water and the degree of bacterial contanmination as measured by coliform, enteric, gram neg., and heterotrophic bacteria. The firm-clot method was a less sensitive and reproducible technique for the detection of endotoxin than the spectrophotometric modification of the Limulus lysate assay. Bound endotoxin as determined by the spectrophoto metric modification of the Limulus lysate assay was a better measure of the endotoxin with the bacterial cells than was total endotoxin.

INDUSTRIAL WASTE, MERCURY, RIVER POLLUTION.

46. CHODYNIECKI (A) and PROTASOWICKI (M). Mercury content in the muscles of carp (cyprinus carpio L) as an indicator

of water pollution. <u>Acta Hydrochim Hydrobiol</u>. 6, 2; 1978; 175-9.

The H_g content in carp muscle increased with increasing water H_g concns. The accumulation coeff. was 913.7. No relationship between H_g content and fish wt. was observed. Fish were not a good indicator of water H_g content, since changes in water H_g content were not immediately reflected in the fish muscle H_g content.

47. *KAMATH (PR) etc. Control of mercury pollution from discharge of industrial effluents to the environment. <u>Chem. Engng. Wld</u>. 11, 9; 1976; 59-63.*

Describes a technique of removing mercury from effluents with the help of a bed of Ferrous Sulphide. Various experiments as described have shown that the Ferrous Sulphide column is efficient for total containment of mercury present ineffluents.

48. *KOMERWAR (AM) etc. Mercury pollution from Chlor-Alkali plants in India and role of TSIA for its abatement. <u>Indian J. Environ. Hlth</u>. 20,3; 1978; 284-9.*

The study aims at bringing to light the pollution problem that arises due to use of mercury in Chlor-Alkali industries and suggests a way for its abadement by the use of Titanium Substrate Insoluble Anodes (TSIA). In India, during 1976about four lakh tonnes of caustic soda was produced by the mercury cell process. About 0.25 Kg of mercury is lost per tonne of caustic soda produced. This creates a serious pollution problem due to the massive contamination of air and waste-water system due to mercury contamination.

INDUSTRIAL WASTE, MINERALS, RIVER POLLUTION.

49. *SRINATH (EG) and PILLAI (S). Observations on some minerals and B vitamins in sewage and sludges. Current Science. 35, 10; 1966; 247-50.*

The nature and extent of removal of phosphates, sulphates, Fe, Ca, Mg, Cu, Zn, Ni, Cr, M, Co and some B vitamins from sewage during treatment are described. Samples drawn from the sewage works, activated sludge plant and the septic tanks at the Indian Institute of Science and from the natural sewage channels at Banglore, as well as those obtained under lab. conditions have been analysed.

50. *SRINATH (EG) and PILLAI (S). Removal of mineral constituents from sewage by sand filters. Indian J. Exp. Biol. 1967; 57-8.*

The removal of Ca, Mg, Fe and P in the initial stages of filteration of sewage through sand filters was largely dependent on the particle size of sand. After ripening of the filters for three weeks, the removal of these elements with the exception of Fe was influenced by microorganisms, particularly Vorticella Sp., developing in the sand filters.

51. *SUNDARESAN (BB) etc. Removal of iron, manganese, copper, arsenic, lead and cadmium by serpentine mineral. Indian J. Environ.Hlth. 20, 4; 1978; 413-9.*

While studying the removal of filterable and total phosphates from aquatic system, it was discovered that mineral serpentine retains metals like iron, manganese, copper, arsenic, lead and cadmium in water to varying degrees. This paper announces the results of these findings. Serpentine has appreciable capacity to retain heavy metals.

INDUSTRIAL WASTE, NITRATE NITROGEN, RIVER POLLUTION.

52. GORMLY (JR) and SPALDING (RF). Sources and concentrations of nitrate-nitrogen in ground water of the central Platte Region, Nebraska. Ground Water. 17, 3; 1979; 291-301.

During 1976-77 NO_3^--N concns. were 10 mg/L in 183 of 256 ground water samples from Buffalo, Hall and Merrick counties, Nebraska. The primary source of contamination was fertilizer; a small percentage of wells significant concns. of NO_3^- - N derived from animal wastes.

53. JEWELL (WJ) and CUMMINGS (RJ). Denitrification of concentrated Nitrate Waste Waters. Jour Water Poll. Control Fed. 47, 9; 1975; 2281-91.

A study was conducted with waste water from an electrical components manufacturing facility to determine the feasibility of using biological denitrification to remove concn. of nitrate nitrogen.

INDUSTRIAL WASTE, NITRILOACETIC ACID, RIVER POLLUTION.

54. ERICKSON (SJ) etc. Affect of Nitriloacetic acid on the growth and metabolism of estuarine phytoplankton. Jour Water Poll. Control Fed. 42, 8(pt 2); 1970; R329-35.

The effects of nitriloacetic acid on estuarine phytoplankton was examined in natural and synthetic river water. The acid is of low toxicity to phytoplankton in the presence of adequate trance metals. The whole molecute is likely to produce trace metals deficiency in river water at relatively low concentration. NTA is biodegradable by estuarine bacteria. Residence time is estuaries should be relatively short. Degradation product is sufficient quantity are likely to promote undesirable algal blooms.

INDUSTRIAL WASTE, NITRITE, RIVER POLLUTION.

55. *NAGARAJU (T) and RAMANA RAO (JV). Nitrite induced Methemoglobinemia in Cat Fish Clarias batrachus (Linn). Indian J. Environ Hlth. 21, 1; 1979; 79-81.*

Experimental exposure to various doses of nitrite in the laboratory to the Cat fish, clarias batrachus, elevated the levels of methemoglobin in relation to controls. Responses of Cat fish clarias batrachus to natural ground water of high nitrite content are also recorded. Nitrite has been described as extremely toxic to aquatic species.

INDUSTRIAL WASTE, NITROGEN-PHOSPHOROUS, RIVER POLLUTION.

56. *BARTH (EF) etc. Chemical-Biological control of nitrogen and phosphorous in waste water effluent. Jour. Water Poll. Control Fed. 40, 12; 1968; 2040-54.*

A treatement sequence has been developed which removes approximately 90% of the influent COD, SS, nitrogen and phosphorous. The modular process consists of high rate activated sludge, nitrification and denitrification integrated into a single continous flow treatment plant. Each of the three biological unit operations hasits own recycle system, so enriched cultures of micro organisms develop.

INDUSTRIAL WASTE, NITROGENOUS COMPOUNDS, RIVER POLLUTION.

57. *FLAIGG (Norman G) and REID (George W.). Effects of nitrogenous compounds on stream conditions. Sew. & Ind. Waste. 26, 9; 1954, 1145-54.*

In this paper it has been reported that higher concn. of nitrogen compounds in a polluted river appear to accelerate the growth of algae so that they are concentrated in a shorter length of river; for this reason the high nitrogen concns. may be more damaging than low concns.

INDUSTRIAL WASTE, NUTRIENTS, RIVER POLLUTION.

58. *KHALATKAR (AS) and SUDIPTAGHOSH. Effect of polluted water on cytomorphology of c.bengalensis Linn. Indian J. Environ. Hlth. 21, 4; 1979; 377-80.*

The entry of excessive nutrients into water bodies through sewage induces growth of phytoplankton which in turn depletes oxygen and causes ecological imbalance. Polluted water was observed to affect several morphological as well as cytological features in c.bengalensis. The leaves of plants growing in polluted water were thicker and smaller than the control plants. The sections of these leaves showed an increase in the size of polisade and mesophyll cells.

59. *SINGH (RC). Experimental study of the death rate of Coli form organisms under aerobic and anaerobic conditions in water with or without nutrients. J. Instn. Engrs. India. 52, 2; 1972; 66-70.*

It is found experimentally that anaerobic conditions decreased the death rate of the Coli form organisms in water having no nutrients. Since these organisms are are used as indirect indices of the pathological quality of water, the finding is of topicalinterest. Anaerobic conditions may be created in bodies of water by addition of certain organic and inorganic pollutants containing practically no pathogens from industrial wastes.

60. *TASGAONKAR (SK). Physio-Chemical treatment of waste water : a possible answer to water pollution. IAW PC Tech. Annual. 5; 1978; 116-22.*

Interest in physical chemical methods of waste water treatment has been created mainly because of the need to remove plant nutrients to prevent entrophicotion. The most common technique for nutrient removal is chemical coagulation of secondry effluents followed by sedimentation and absorption on activated carbon. Though this technique probabely proves to be more expansive than conventional biological treatment but would produce a very high quality effluent which could probabely be re-used industrially.

<u>INDUSTRIAL WASTE, ORGANIC MATERIALS, RIVER POLLUTION</u>.

61. *SRIDHAR (MKC) and PILLAI (SC). Microbiological changes in water polluted with organic materials. <u>Arogya</u>. 1, 1; 1975; 42-53.*

Some evidence has been collected on the microbiological changes in samples of water polluted with the following materials : ground-nut cake, casein, leaf powder, straw powder, starch, farmyardmanure, synthetic sewage a mixture of all these, and domestic sewage. Experiments show that while the bacteria are mainly responsible for the depletion of oxygen, reaeration and the later increase in Do are due to the development of protozoa particularly of the Vorticellid type.

<u>INDUSTRIAL WASTE, ORGANC PHOSPHATE, RIVER POLLUTION</u>.

62. *VERMA (SR) etc. Organophosphate poisoning to some fresh water teleosts-acetylcholineterase inhibition. <u>Bull. Environ. Toxicol</u>. 21, (4-5); 1979; 502-6.*

Sublethal levels of zolone (I) 2310-17-0 , Rogor 60-51-5 and malathion 121-75-5 Inhibited the activity of acetylcholinesterase 9000-81-1 in the brain, liver and muscle of channa gachua and cirrhina mrigala. The inhibition was concn.-dependent. Thus a sublethal level of organophosphate may result in an inability to sustain *their physical activity, and to maintain their body balance. Fish may die under these stresses.*

INDUSTRIAL WASTE, PARASITES, RIVER POLLUTION?

63. *PANICKER (PVRC) and KRISHNAMOORTHI (KP). Elimination of Enteric Parasites during sewage treatment processes. IAWPC Tech. Annual. 5; 1978; 130-8.*

It discusses the effect of various sewage treatment processes, both conventional and non-conventional, on the elimination of the cysts and eggs of the parasites from sewage. Among the conventional ones, activated sludge and trickling filter are discussed in this regard. Except for a few sporadic reports on stabilization ponds, no data seem to exist on the elimination of parasites in the case of biological dise, aereated lagoon and oxidation ditch among the non-conventional low cost methods. Unpublished data of the authors regarding these treatment methods are also discussed. The best performance as far as the elimination of cysts and eggs are concerned was observed in the case of stabilization ponds, suggesting its superiority over the others.

64. *VEERANNAN (KM). Effect of sewage Treatment by Stabilization Pond method on the survival of Intenstinal Parasites. Indian J. Environ Hlth. 19, 2; 1977; 100-6.*

The efficiency of stabilization pond method of treating sewage in reducing parasitic cysts and ova in three different stabilization ponds has studied. The pond at T.B. Sanatorium, Tambaran is relatively more efficient in reducing protozoan cysts (up 100%) whereas, the pond at kodangauyur is found to be comparatively more efficient in reducing helminthic ova. The results proved that the stabilization pond method is efficient in reducing parasitic systs and ova.

INDUSTRIAL WASTE, PARTICULATES, RIVER POLLUTION.

65. *DAVE (JM) and MAIRA (SK). Pollution due to particulates and its control in industry. Chem Age India. 27, 3; 1976; 304-9.*

Some important industries from the point of view of particulate matter are discussed. It also provides an idea of the approaches commonly recommended for controlling the particulates from these industries. Some important emission data from different industries have also been given.

INDUSTRIAL WASTE, PESTICIDES, RIVER POLLUTION.

66. *DESHPANDE (MM). Environmental pollution due to pesticides. J. Instn Engrs. India. 56, 1; 1975; 23-5.*

The effects of pollution by different pesticides (organic and inorganic) on the environment namely, soil, water and air, which will ultimately affect human beings, are discussed. Some useful data such as pesticides used for crop protection in India during 1957-58, lethal limits to fish for various pesticides and persistence of some common pesticides in soil are given.

67. *REDDY (T Gopal Krishna) and GOMATHY (S). Toxicity and respiratory effects of Pesticide Thiodan on catfish, Mystus Vittatus. Indian J. Environ. Hlth. 19, 4; 1977; 360-3.*

The pesticide, Thiodan has been shown to be highly toxic to catfish, Mystus Vittatus. Sub-lethal concentrations of the pesticide was shown to lower the oxygen consumption in contrast to the elevating effect of lethal concentrations.

68. SAXENA (KL) and CHAKRABARTI (T). Organic Pesticides and their removal from aqueous system. Indian J. Environ Hlth. 20, 4; 1978; 334-53.

The paper briefly discusses the in formation on chemistry of Pesticides, their classification, methods of waste treatment practices currently followed and limits of different Pesticides in the effluent for discharge into water courses. The major treatment methods include absorption, chemical oxidation, caogulation and biological degradation.

69. VERMA (SR) and GUPTA (SP). Pesticides in relation to water pollution (accumulation of aldrin and ethyl parathion in a few tissues of Colisa fasciatus and Noto-pterus notopterus). Indian J. Envir. 18, 1; 1976; 10-4.

Deals with the quantitative measurment of aldrin and ethyl parathion in liver, intestine, kidney and muscles of C. fasciatus and N. notopterus after treatment for 4 hours, 5 days and 15 days. Both the pesticides accumulated maximum in liver and minimum in intestine. It was also noted that on giving the maximum dose of pesticide, it accumulates sooner in comparison to min. dose.

INDUSTRIAL WASTE, PETROCHEMICALS, RIVER POLLUTION.

70. PICKERING (QH) and HANDERSON (C). Acute toxicity of some important petrochemicals to fish. Jour. Water Poll. Control Fed. 38, 9; 1966; 1419-29.

Static bioassays conducted to determine the acute toxicity of certain petrochemicals to several species of fish in both hard and soft water showed that the mean tolerance limit at 96 hr for most of the chemicals fell in the range of 12-97 mg/l. Blue gills generally the most sensitive species tested followed by fat heads, gold fish, and guppies, although variation in sensitivity was small. A few of the compounds appeared slightly more toxic in soft water than in hard water.

INDUSTRIAL WASTE, PHARMACEUTICAL, RIVER POLLUTION.

71. KADAM (RV) and KANI (KM). Application of BOD moderator for treatment of pharmaceutical wastes. J. Instn. Engrs. India. 46, 10; 1966; 130-9.

The feasibility of using a BOD moderator for treating the pharmaceutical wastes has been examined. From the analysis of results, it is seen that BOD moderator described effects reduction in BOD which is about 84-80% at the loading rate of 1200-1600 g/hr and is less sensitive to sudden increase in the supply of toxic chemicals and at low pH-value. The moderator works without any obnoxious odour and thus it is free from health hazards.

INDUSTRIAL WASTE, PHENOL, RIVER POLLUTION.

72. PRASAD RAO (IPS) etc. Laboratory studies on biological treatment of phenolic wastes by oxidation ditch. Envir. Hlth. 11, 1; 1969; 23-31.

The results obtained with lab. model oxidation ditch operating at one day detention period are encouraging. An aeration time as tow as 8 hr. is quite sufficient to destroy mainly phenols almost completely besides obtaining moderate removals in BOD and COD values. The usual indicator organisms of good activated sludge disappeared at the concentration of waste tried and their place was taken up by the fungus, Geotrichum sp.

73. SHIVARAMAN (N) etc. Phenol degradation by candida tropicalis and influence of other Toxicants. Indian J. Environ. Hlth. 20, 2; 1978; 101-11.

Among the various toxic substances present in industrial effluents, phenol is one of them to cause ill-effects on receiving waters. Hence a waste containing phenol needs careful treatment before its discharge into the receiving body of waters. The yeast candida tropicalis was isolated from soil and studied for phenol degradation. Influence of eyanide, ammonia and thiocynate on phenol degradation was also studied. Results indicate that the culture is capable of degrading phenol up to a concentration of 2000 mg/1 in 440 mg/1 (dry weight).

74. *SRINIVASAN (MV). Experimental studies on the biological treatment of phenol. __Envir. Hlth__. 7, 1; 1965; 49-53.*

A strain of bacteria isolated from local soils, has been found to Oxidisephenol biologically. Various factors like loading, concentration, rate and time of aeration, percent sludge in the mixed liquid have been studied in the laboratory. It was observed that temp. in the range of 22-35°C are preferable and initial concentration of phenol as high as 1,200 mg/l. could be tolerated by these organisms.

__INDUSTRIAL WASTE, PHOSPHATE, RIVER POLLUTION__.

75. *BULUSU (KR) etc. Phosphate removal by serpentine mineral. __Indian J. Environ Hlth__. 20, 3; 1978; 268-71.*

It describes the interaction of poly-phosphates on destabilisation of the water-borne suspended solids and how the mineral serpentine can be used for the removal of filterable and total phosphates from an aquatic system. The study also revealed that surpentine has a high affinity for ortho and condensed suluble phosphates.

INDUSTRIAL WASTE, PHOSPHORCUS, WATER POLLUTION.

76. COPELAND (BJ). Effects of industrial waste on the marine environment. Jour. Water Poll. Control Fed. 38, 6; 1966; 1000-22.

High phosphorous concns., reducing Ohlc anomalies and redox potential and low species diversity in st. Joseph's Bay indicated some degree of Organic pollution. Although some industrial effluents did not kill 50% of the fish, they caused a decided increase of the fish's metabolic rates. Long periods of retention allowed biological communities in industrial effluents to stabilize to the point of balance.

77. PIRNER (Steven M) and HARMS (Leland L). Sewage collection; Rapid City Combats; the effects of urban run off on surface water. Water Sewage Works. 125, 2; 1978; 48-53.

Construction activities in a large residential developments suseptible to water and wind erosion, resulted in high sediment concns. in the Meade Street Basin run off in Rapid City, South Dakota. Because of the absence of decidous trees in the basin, P content of the run off water was lower than in urban run off. Correlation Coeffs. of 0.85-0.98 were found between run off vol. and stream loading for various parameters. A substantial portion of the sediment is colloidal and is not removable by sedimentation.

78. WELCH (Eugene B) and LINDEIL (L Tomey). Phosphorous loading and response in lake vanern nearshore areas. Environ Sci. Technology 12, 3; 1978; 321-7.

P(Phosphorous) retention in archipelagic areas of Lake Vanern Sweden, was estimated and the observed local impact on tropic state was compared with that predicted from steady state consideration. Half of the incoming

P was retained in near shore areas. With reasonably good data on P loading retention coefficient and flashing rate at least crude productions of trophic state. Changes and retention capacity are possible in Archi pelagic areas of large lakes.

<u>INDUSTRIAL WASTE , PHOSPHOROUS, RIVER POLLUTION</u>.

79. *MISHRA (GN). New approach to sewage treatment-chemical precipitation. <u>Indian J. Environ. Hlth</u>. 21. 3; 1979; 271-7.*

Where land costs are high, this process of treatment of sewage by alum will be economical. This method also removed some dissolved elements including phosphorous.

EQ. INDUSTRIAL WASTE, PHO

80. *SASTRY (CA). Removal of phosphorous from sewage by different methods of treatment. <u>Environ Hlth</u>. 7, 4; 1965; 213-9.*

Phosphorous is rapidly removed from sewage by activated sludge process, but only to a limited extent by percolation through a trickling filter. Phosphorous can be removed effectively from trickling filter effluent by treatment with suitable quantity of lime or by passing through sand filters.

81. *SRINATH (EG) etc. Phosphorous contents of sewage-polluted waters. <u>Indian J. Exp. Biol</u>. 4, 2; 1966; 114-9.*

Sewage-polluted waters contain considerable amounts of P, a large part of which is water soluble. When sewage samples are dilluted with tap water in different proportions and the diluted samples allowed to stand or artificially aerated for 15 days, the amount of water soluble P in the supernatat liquids are not appreciably altered.

Waters which are not polluted with sewage may also contain P, depending on the nature and extent of their contamination with other forms of organic matter.

INDUSTRIAL WASTE, RADIUM, RIVER POLLUTION.

82. *BANERJEE (P) and CHATTERJEE (SD). Radium contents of the Ganges Water. Science & Culture. 32, 4; 1966; 178-80.*

Twenty litre of Ganges water collected at different places have been chemically treated to ppt. the radium salt in it as sulphate and the ppt. freed of silica has been fused. The radium content in both the water as well as in the in soluble deposits have been determined using a calibrated ion chamber and compared with similar data for other rivers. The change in radium content of the Ganges water along its course has been explained on the basis of the geographic distribution of natural radioactive minerals in the region.

INDUSTRIAL WASTE, SALINE, RIVER POLLUTION.

83. *CHEN (W) etc. Affects of salinity on nitrification in the East river. Jour. Water Poll. Control Fed. 47, 10; 1975; 2474-81.*

The rates of nitrification in water samples obtained from different locations of the East river, New York, from Dec. 1971 to March 1972 were determined. Salinity was one main factor responsible for the inhibition of nitrification. Pure cultures of nitrifying bacteria isolated from the river water showed varying degrees of Nacl tolerance.

84. *CHETTY (NV Chandra Sekhara). Utility aspects of the river waters polluted by Saline intrusion in Goa territory. IAWPC Tech. Annual. 5; 1978; 46-68.*

The author has collected elaborate data from various authentic sources, concerning this aspect of environmental pollution of rivers by salt water intrusium in Goa Territory. After due analysis and assimilation of this data, he has made an attempt, in suggesting some pragmatic remidial measures to explore the possibilities of usage of these Saline affected river waters for seasonal irrigation, seasonal industries and for drinking water supply.

INDUSTRIAL WASTE, SODIUM CHLORIDE, RIVER POLLUTION.

85. DICKMAN (MD) and GROCHNAUR (MD). Impact of sodium chloride on the microbiota of a small stream. Environ. Pollution. 17, 2; 1978; 109-26.

The addition of 1000 ppm. Nacl to a small stream in order to stimulate road salt loading resulted in a reduction in algal diversity and an increase in Bacterial diversity on artificial substrates left in the stream over a 4 week period. The scanning electron microscope was used to examine changes in the spatial pattern of organization of the periphyton community colonizing the artificial substrates. Algal diversity was lower at the salt stressed station while phytophagous grazers wer far more abundant at the salt free control stations. Bacterial densities were significantly higher at the salt treated station while algal densities on the salt exposed substrates were significantly lower than those on the control slides.

INDUSTRIAL WASTE, SODIUM TRIPHOSPHATE, RIVER POLLUTION.

86. MALONEY (TE). Detergent phosphorous effect on Algae. Jour. Water Poll. Control Fed. 38, 1; 1966; 38-45.

Lab. studies indicate that the sodium triphosphate ingredients of a syndet (ABS) stimulates the growth of the unicellular algae ~~chlorella~~ phyrenoidosa. Other ingredients have no apparent effect on growth.

Algae is capable of both using sodium triphosphate directly for growth and accelerating the hydrolytic breakdown through extra cellular enzymes to less condensed phosphates.

INDUSTRIAL WASTE, SOLIDS, WATER POLLUTION.

87. *OLANIYA (MS) and SAVENA (KL). Ground Water pollution by open refuse dumps at Jaipur. Indian J. Environ. Hlth. 19, 3; 1977; 176-88.*

This study on contamination of ground water due to leachate from around refuse dumping grounds at Jaipur has shown that pollution by dissolved solids, chloride and iron salts, exists upto a distance of 450 m. The increase in hardness and COD are pereeptible up to about the same distance. The soil was mostly 'non-calcic brown' (sandy) type. It has been suggested that the problem can be minimised by choosing a proper site for refuse dumping. Open dumping or dumping in low laying areas should be avoided in arid and semi-arid zones. For such areas sanitary land filling or scientific compsoting should be adopted.

INDUSTRIAL WASTE, SPILL, RIVER POLLUTION.

88. *McDERMOTT (GN). Industrial spill control and pollution incident prevention. Jour. Water Poll. Control Fed. 43, 8; 1971; 1629-39.*

Pollution can result from spills or equipment mal functions in industrial plants. Spills that drain to water cources directly or through storm sewers are a serious problem. Spilled materials should be conducted to the process or sanitary sewer or storm run off to the storm sewers. Pollution incidents from once through cooling water systems can be prevented by conversion to recirculated systems.

INDUSTRIAL WASTE, SULPHIDE, RIVER POLLUTION.

89. SALEM (AY) and RAHIM (SA). Elimination of sulphides from highly sulphurettled natural waters-application to natural water of 'Hammam Al Ali-1' Spring, Iraq. Indian J. Environ. Hlth. 14, 2; 1972; 150-8.

Aeration and chemical treatment methods have been studied and evaluated taking natural water of 'Hammam Al Alil' Spring, Iraq as a standard. Aeration followed by a secondry treatment with hypochlorite is recommended.

INDUSTRIAL WASTE, THERMAL DISCHARGE, RIVER POLLUTION.

90. BUCK (JD) and RANKIN (JS). Thermal effects on the connecticut river : Bacteriology. Jour. Water Poll. Control Fed. 44, 1; 1972; 47-65.

The study of the effect of thermal discharge from the connecticut yankee atomic power company plant on the connecticut river was made to determine whether selection of certain metabolic groups would occur as a fuction of the thermal effluent, and if so, how the change might affect the biochemical pottential of the river. Results indicate that no drastic changes in the bacterial communities occured because of the increased temperature of the river.

INDUSTRIAL WASTS, TITANIUM DIOXIDE, WATER POLLUTION.

91. FADER (SW). Barging industrial liquid wastes to sea. Jour. Water Poll. Control Fed. 44, 2; 1972; 314-8.

Industrial wastes from the production of titanium dioxide pigment are barged to sea from Edge Moor, Delaware.

The barge is unmanned and is steered, unloaded and flushed out by use of electronic controls operated from a tug board. Biological tests are conducted to assess pollutional effects on the receiving sea water; no ecological damage has been found to be attributable to this particular waste.

INDUSTRIAL WASTE, TOXIC CONSTITUENTS, RIVER POLLUTION.

92. SETH (AK) etc. Monitering of certain toxic constituents in water supplies by fish. Envir. Hlth. 9, 1; 1967; 34-8.

The limits of toxicants that fish can detect was ascertained by regular bioassay studies. It was observed that cyanide up to 0.1 mg/lit. could be detected by fish in an hour. However, certain other chemicals in concn. permissible in water supplies could not be detected by fish.

INDUSTRIAL WASTE, TURBIDITY, RIVER POLLUTION.

93. CHAUDHURI (M). Upflow contact basin-a simple and rapid method for turbidity removal. Envir. Hlth. 8, 3; 1966; 219-21.

Laboratory studies and experiments conducted for turbidity removal using the principles of solids contact and upflow have been reported. Influence of turbidity was kept constant at 100 to 110 mg/lit., since it was found that influent turbidities up to 305 mg/lit. had little influence on the effluent quality.

INDUSTRIAL WASTE, VIRUSES, RIVER POLLUTION.

94. CHALAPATI RAO (V) etc. Developments in environmental virology in India. IAWPC Tech. Annual. 5, 1978; 1-16.

Significant contributions in water, waste water and food virology during the past decade in India are high lighted. They include development of simple and inexpensive methods for concentration and enumeration of viruses in raw sewage and effluents; an in sight into dirunal and seasonal variation in the quality of viruses in domestic waste water; evaluation of the viruses removal efficiency of the costly environmental sewage treatment systems as well as low cost waste treatment plants, and the problem of upto the of viruses by shell fish inhabiting polluted waters.

95. *REID (LW). Waste water pollution and general entrophication of a hydroelectric impoundment. Jour. Water Poll. Control Fed. 38, 2; 1966; 165-74.*

Lake Maraetai, a hydroelectric impoundment in New Zealand, has experienced waste water pollution and cultural enrichment. Cases of disease in a twon drawing its water supply from the lake are attributed to viruses carried in the surface water of the lake polluted by the towns waste water. The depth of the out fall was increased to ensure discharge of waste water below the water level in the summer, when the lake is thermally satisfied. Pollution still is possible under isothermal conditions.

INDUSTRIAL WASTE, ANIMAL INDUSTRY, RIVER POLLUTION.

96. *ROBBINS (J WD) etc. Stream pollution from animal production units. Jour. Water Poll Control Fed. 44, 8; 1536-44.*

Twelve typical agricultural areas representing, three types of animal waste management techniques-land spreading including pasture and dry lot units, lagooning and direct discharge into streams-were studied to determine the factors governing stream pollution from swine, dairy, poultry and beef production operations. Use of anaerobic lagoons alone is unsatisfactory and dumping *of wastes directly into streams causes excessive pollution. Land spreading is an effective means of preventing pollution.*

INDUSTRIAL WASTE, APPLIANCE INDUSTRY, RIVER POLLUTION.

97- *ANDERSON (JS) and LOBST (EH). Case history of waste water treatment in a general electric appliance plant. Jour. Water Poll. Control Fed. 40, 10; 1968; 1786-95.*

Waste water discharges from a small appliance plant are treated to remove metal ions, acids and alkalis. The initial equipment installed and the manner in which the treatment system had to be expanded to keep pace with expanding manufacturing operations are discussed.

INDUSTRIAL WASTE, CHEMICAL INDUSTRY, RIVER POLLUTION.

98. *GADGIL (LS) and SUBRAHMANYAM (PVR). Treatment of waste waters from organic chemical industry. Chem. Ind. Dev. Annual, 1975; 121-9.*

The importance and growth of organic chemical industry have been mentioned. The nature of pollution from the industry has been highlighted. The available methods of treatment for the biologically treatable, intractable and highly toxic wastes have been discribed in detail. The importance of in-plant control methods in reduction of pollution is stressed. Waste treatment methods developed by NEERI (Nagpur) and adopted by some of the chemical industries in India have been dealt with in detail.

99. *GHOSH (BB) and BASU (AK). Estuarine pollution of the Hooghly by the effluents from a chemical factory complex at Rishra, West Bengal (India). Envir. Hlth. 10, 3; 1968; 204-18.*

The Hooghly estuary, because of its heavy mixing and high turbulence, has appreciable vertical stratification in respect of salinity and there is a possible deterioration in the water quality of the Bager canal water. Along the down stream, the estuary recovers from pollution due to high dilution and heavy mixing as it travels a distance of about 3.5 Km. down stream for fish-propagation. The mid-stream points were found to be favourable, where as in the down stream stretch, upto a distance of 3.5 Km., they are not congenial for sustaining fish life.

100. MANJU AGARWAL and KUMAR (HD). Physico-chemical and phycological assessment of two mercury-polluted effluents. Indian J. Environ.Hlth. 20, 2; 1978; 141-55.

Physico-chemical and biological analysis of effluents discharged by the Kanoria Chemical factory, Renukot and the Rohtas paper factory, Dalmianagar showed that the main cause for the absence of algae in the effluent was the presence of mercury. Other subsidary and contributory factors were the presence of zinc, copper, chlorides and organic matter, and the deficiency of some major nutrients like phosphate and nitrate.

101. MUDRI (SS) etc. Treatment of wastes from dimethyl terphthalate plant. Indian J. Environ.Hlth. 14, 1; 1972; 46-61.

Bio-degradability studies using acclimatised activated sludge showed that 98.99% BOD reduction could be obtained at an organic loading of 0.16 Kg.BOD/d/Kg MLSS. Based on the experimental data, it was found that a 2-stage biological treatment system using a combination of aerated lagoon and oxidation ditch will provide effluent of the desired quality.

102. OLANIYA (MS) etc. Pollution studies of Chambal river and its tributaries at Kota. Indian J. Envir.Hlth. 18, 3; 1976; 219-26.

Pollution studies of Chambal river were carried out for 2 years. Sources, volume and nature of waste water discharged by Shriram Chemical Industries, Kota were found out. The effect of waste water on the physico-chemical quality of the river water were investigated upto a 33 Km. stretch from source of pollution and the results are presented.

103. RANA (BC). Effects of chemical factory waste on Algae. Indian J. Environ. Hlth. 19, 3; 1977; 259-60.

The highly alkaline chemical waste with high COD and containing nitrogen and chlorides, in addition to adversely affecting the water quality, also greatly disturbes the natural lecosystem by affecting the growth of the aquatic flora and fauna. Absence of the algae in the river waters is due to the highly toxic nature of the effluent.

INDUSTRIAL WASTE, CYCLE INDUSTRY, WATER POLLUTION.

104. HANDA (BK). Occurance of heavy metals and cyanides in ground water from shallow aquifers in Ludhiana. IAWPC Tech. Annual. 5, 1978; 109-15.

The analysis of ground water samples from shallow aquifers in Ludhiana showed in some cases anomalous concentrations of nickle. iron. chromium. copper and cynide. The analysis of effluent waste waters from cycle industries was done from the same area. The analytical data showed relatively high concentrations of these constituents in the waste effluent waters, and seem to be the main cause for pollution of ground water.

INDUSTRIAL WASTE, DISTILLERY INDUSTRY, RIVER POLLUTION.

105. VAIDYANATHAN (KR). Disposal of distillery effluents. Chemical Age India. 23, 4; 1972; 281-3.

Different methods are studied and it is concluded that a see page lagoon and an aerated logoon do an excellent job in treating distillery waste.

INDUSTRIAL WASTE, DYE INDUSTRY, RIVER POLLUTION.

106. GHATE (HV) etc. Effect of dye factory effluent on developing embroys of Microhyla Ornata. Indian J. Environ. Hlth. 20, 4; 1978; 359-65.

The dye factory effluent is teratogenic at all the concentrations employed and the percentage of abnormal tadpoles increased with increase in concentration of the effluent. The major abnormalities were to the tail, eye and oedematic growths on head and tail.

INDUSTRIAL WASTE, ELECTRO PLATING INDUSTRY, RIVER POLLUTION.

107. BANERJEE (PK). Treatment of effluents from electroplating industry. Indian Chem. Mfr. 17, 10; 1976; 11-5.

Discusses the importance of treatment of effluents generated by electroplating industry in the country. The category of effluents from the electroplating industry have been mentioned and their treatment processes described.

INDUSTRIAL WASTE, EXPLOSIVES INDUSTRY, RIVER POLLUTION.

108. BEDRI (SS) etc. Characteristics of wastes from an explosives factory and effect of the wastes on river water. Envir. Hlth. 9, 3; 1967; 220-30.

The wastes from a factory producing trinitrotoluene and tetryl, were highly acidic and coloured and comparatively low in BOD. The solid content was considerable in the effluent of one drain, but was lower in the other two. Moderately high values of different forms of nitrogen, and sulphates, principally contributed by acid wash waters, were present. The low BOD made the treatment by biochemical oxidation difficult. The yellow colour persisted in the river water even at a distance of 10 Km.

INDUSTRIAL WASTE, FERTILIZER INDUSTRY, WATER POLLUTION.

109. DUTTA (PK) etc. Control of environmental pollution in fertilizer industry. J. Instn. Engrs. India, 56, 1; 1975; 8-12.

Control of pollution from emmissions and effluents of fertilizer industry and control from solid wastes from solid wastes from fertilizer industry are discussed.

110. RAO (P Murahari) etc. Studies on characteristics and and treatment of waste waters from a fruit processing industry : a case study. Indian J. Environ.Hlth. 20, 4; 1978; 309-24.

In-plant surveys were conducted in typical mango and tomato processing units. The waste waters were found to be deficient in nitrogen and phosphorous. After neutralisation of the waste water with lime to a PH of 6.0 to 7.0 and addition of nutrients in the form of urea and phosphoric acid or sewage, the waste water could be treated in an oxidation ditch or aerated logoon.

INDUSTRIAL WASTE, KRAFT INDUSTRY, RIVER POLLUTION.

111. NG (KS) etc. Ozone treatment of kraft mill wastes. J. Wat. Poll. Cont.Fed. 50, 7; 1978; 1742-9.

Four batches of bleached draft whole-mill effluents were treated with various amounts of ozone in batch and dynamic systems. Removal of toxicity, color, BOD and TOC were monitered as a function of pH and ozone dosage. This treatment is most effective for removal of color, less effective for removal of BOD and least effective for removal of TOC.

112. SUBRAHMANIAN (PVR). Colour in pulp mill wastes and its removal. IAWPC Convention Vol. 3; 1976; 16-33.

Kraft pulp mills discharge dark brown coloured wastes, which is due to lignin and its derivatives, which in turn create aesthetic pollution, and reduce the utility of the water and increase the cost of its treatment. Among the chemical methods employing precipitation or Coagulation, massive lime treatment for colour removal has been found to be technically and economically feasible.

INDUSTRIAL WASTE, PAPER INDUSTRY, RIVER POLLUTION.

113. BARTON (CA). A total systems approach to pollution control at a pulp and paper mill. Jour. Water Poll. Control Fed. 40, 8; 1968; 1471-86.

A new pulp and paper mill on the sysquehanna river was designed with a pollution control facility as an integral part. Spent liquors from the sulphite pulping process, high in oxygen demand but low in suspended solids are concentrated and burned, more dilute pulping wastes are treated by an activated sludge process. White water from paper making is scree-ned, passed through an aeration flotation unit and recirculated. Wastes from leaks and spills are treated by rotary screening.

114. BASU (AK). Studies on effluents from pulp-paper mills and its role in bringing the physico-chemical changes

around several discharge points in the Hooghly river estuary, India, J. Instn. Engrs. India. 46, 10; 1966; 107-16.

The pollution load contributed by effluents of the major pulp-paper mills situated in and around the Hoogly river estuary was estimated as 40,040 lb. per day of BOD; 322, 820 lb. per day of suspended solids, and 54,210 lb. per day of lignin. The physico-chemical conditions in the close vicinity of discharge points of the effluents indicated that they were not satisfactory. But owing to the tidal mixing, flow and the large volume of mixing water, the immediate effects of pollution arising out of the pulp-paper mill effluents on the receiving waters were negligible.

115. COTTLE (BJ) etc. Treatment of combined kraft and news-print effluents at an Alabama paper mill. Jour. Water Poll. Control Fed. 40, 7; 1968; 1314-31.

Construction of power dams on the Coosa river, Alabama, above a mill producing fully bleach kraft pulp and new-print reduced the oxygen content of water coming to the mill, and raising the height of a dam down stream will reduce the reaeration capabilities of the river. Under water weirs above the two up stream dams have increased the dissolved oxygen in water coming to the mill. The final lagoon allows release to the river to be coordinated with river flows.

116. MOHAN RAO (GJ). Effluent treatment problems in paper industry. Sirpur Industries Journal. 42, 2; 1965; 103-8.

A few methods for reducing the pollution from the paper mills have been suggested followed by the methods of treatment and disposal. The criteria for the selection of the method of treatment are given.

117. MOTWANI (MP), etc. Some observations on the pollution of the river some by the factory effluents of the Rohtas industries at Dalmianagar (Bihar). Indian J. of Fisheries. 3,2; 1956; 334-67.

Hydrometric observations on the river show that the pollution due to the wastes from paper mill is fell only during the low flow period of the river when the river below the Dehri Weir assumes the characteristics of a narrow stream of sluggish current with 100-150 cuseas of discharge. The high organic contnet of the water draws heavily on the oxygen budget of the stream and changes the water quality and bottom condition of the river for a streach of about 15 miles which affects adversely the environmental condition of both the fish and fish food organisms. The sector studied may be divided into five zones according to the degree of polution. Distribution of fish fanna botom biota and planton organism in these zones, in relation to physio chemical condition, has been discussed. It appears that the main damage is caused to the carp fisheries. The available fishes in the affected area are not relaised as food because of the peculiar offensive smell of fishes.

118. MURTY (YS) etc. Studies on the waste disposal problem of Andhra paper mills, Rajahmundry. Envir. Hlth. 7, 1; 1965; 17-23.

Attempts were directed to sanitary disposal of the wastes without the need for any costly treatment. Determination of volume and characteristics of different wastes, stream pollution studies, study of soil characteristics, evolution of design criteria for leaching and evaporation lagoons are some of the aspects studied. Leaching and evaporation lagoon at a suitable site and controlled discharge into river Godavari at a suitable point, if and when necessary, have been recommended to avoid stream pollution.

119. SASTRY (CA) etc. Treatment of waste water from small paper mill without soda recovery : A case study. Indian J. Environ Hlth. 19, 4; 1977; 346-59.

Small paper mills do not normally go in for soda recovery because it is uneconomical. As soda recovery is not practised, the pollution load from these mills is considerably higher than the load from bigger mills with soda recovery. Treatment of waste waters by low cost methods using aerated lagoon is described in this paper.

120. SAXENA (KL), etc. Physico-chemical and settling characteristics of waste water from a waste paper and straw based paper mill. Indian J. Environ. Hlth. 21, 3; 1979; 205-20.

The paper describes the physico-chemical and settling characteristics of waste water from a small paper mill producting about 7 tonnes of writing, printin, wrapping kraft and cover paper per day. The volume of waste water was 216 mts^3 and pollution load in terms of BOD COD and SS were 153, 394 and 327 Kg per tonne of paper respectively. The pollution equivalent per tonne of paper is 3000.

121. SAXENA (KL) etc. Settling studies on pulp and paper mill waste water. Indian J. Environ. Hlth. 20, 3; 1978; 273-83.

The combined waste water from an integrated pulp and paper mill using suphate process of pulping has an average suspended sdids concentration of 500 mg/l and exerted a BOD value of 188 mg/l. The percent sodium in the combined waste water is 3.5. The study showed that settling of combined waste water removed suspended solids and COD by 70% and 52% respectively. The low removal of COD might be due to the lignin present in the soluble form in waste water.

122. SMITH (DR) and BERGER (HF). A chemical-physical waste water renovation process for kraft Pulp and paper wastes. Jour. Water Poll. Control Fed. 40, 9; 1968; 1575-81.

The nature of pulp and paper wastes makes it difficult to obtain the necessary reductions of BOD, color and dissolved solids with a single treatment process. A four-stage process utilising line dosing, biological treatment, activated carbon filtration and demineralisation was used on bleached and unbleached kraft total-mill-effluent. A three stage system without biological treatment also was tested.

123. SREENIVASAN (A) etc. A note on the indicators of pollution of river Cauvery by Pulp mill E. effluent. Indian J. Environ. Hlth. 19, 2; 1977; 141-2.

Treated effluents from the pulp and paper mills at Pallipalayam (Tamil Nadu) are discharged into river Cauvery. At the out fall it was virtually abotic though the water quality itself was not critical. Not only fish but plankton, insects were absent. The predominant organism of this strongly polluted area was the rat-tailed maggot Eris talis sp. These were not noted in Feb. and March but were noted from April. The sluge-worm Tubifey sp. was also noted at the out fall zone. During February-March and later in the second fortnight of July when water flow in the river Cauvery was greater and when the organic carbon content of cutfall was lower neither Eristalis sp. nor Tubifex sp. nor sewage fungus were noted. Eristalis and Tubifex have been associated only with strong sewage pollution and anoxic waters.

124. VERMA (SR) etc. Studies on the toxicity of pulp and paper factory wastes to the fish Notopterus notopterus (Pallas). Acta hydrochim. Hydrobiol. 6, 6; 1978; 541-51.

Studies were performed on the toxicity to N. notopterus for 24, 48, 72 and 96h in the static test with dilns. of 10-32 vol% of waste water from pulp and paper production as well as of mixed waste water. The pulp waste showed the highest toxic effect, the median lethal concn. of the 3 types of waste water being between 15 and 27% in dependence on the test conditions. A general increase of the toxic effect was caused by a rise in temp. from 26 to 36° and an increase in pH from 7.5 to 8.2.

INDUSTRIAL WASTE, PRINTING PRESS, RIVER POLLUTION.

125. SAXENA (KL) and SUBRAHMANYAM (PVR). Treatment of waste waters from a Bank Note Printing Press. Indian Chem. Mfr. 14, 5; 1976; 21-5.

The sources of waste water and the characteristics of waste water have been elaborated. Treatment of waste waters by chemical and biological methods have been described.

INDUSTRIAL WASTE, STRAW-BOARD INDUSTRY, RIVER POLLUTION.

126. SRINIVASAN (MV) and DIXIT (SN). Anaerabic digestion of cooker liquor from straw-board mills. Envir.Hlth. 8, 3; 1966; 174-8.

Anaerobic digestion of segregated cooker liquor from straw-board mills for production of gas has been studied. The digester could be quite successfully loaded to a max. of 0.18 lb. of Volatile matter/cu ft/ per day by providing a detention time of 25 days. The feeding of the digester should be regular and continous. The volatile matter destruction was up to 90% by this treatment.

127. SRINIVASAN (MV) etc. Pond study of straw board waste treatment. Envir. Hlth. 10, 2; 1968; 149-58.

The results of a pilot plant study on straw board wastes with two stage stabilisation pond have been presented. Studies confirmed that the two systems inoculated with Scenedesmus worked well. The pond could bring about a 80-90% reduction in BOD at 150 lb BOD/acre/day. Scenedesmus showed greater preference for straw board waste and its growth was profuse when compared to other algae. Possibilities for algal harvesting for protein has been discussed.

INDUSTRIAL WASTE, SUGAR INDUSTRY, RIVER POLLUTION.

128\. *BANERJEA (S) and MOTWANI (MP). Some observation on pollution of the Suvaon stream by the effluents of a Sugar factory, Balrampur (U.P.). Indian J. Fish. 7, 1; 1960; 107-28.*

The pollutional effects of the wastes from a sugar factory at Balrampur (U.P.) on the fish and factory of the river Suvaon, a small tributory of Rapti, has been studied. Experiments conducted show that the wastes do not contain any substances directly toxic to fish life, the pollution being purely of organic nature. As the factory operates on a seasonal basis only and that there is no scarcity of land in the locality, cheap and effective remedial measures for improvement of the environment have been suggested.

129\. *BAIGGI (N). The Sugar industry in Puer-to Rico and its relations to the industrial waste problem. Jour. Water Poll. Control Fed. 40, 8; 1968; 1423-33.*

Although the Sugar industry in Puerto Rico is declining it poses continued waste problems. Its wates include baggase, filter cake cooling and condenser waters and concentrated wastes from spillage, leakes, washing etc. Concentrated wastes, though of low volume, may have extremely high oxygen demands. The government should give financial incentives for waste control, particularly that accomplished by inplant measures rather than treatment.

130\. *DAVID (A) and RAY (P). Pollution of the river Daha (N. Bihar) by Sugar and distillery wastes. Envir.Hlth. 8, 1; 1966; 6-35.*

The hazardous effects of sugar and distillery wastes on the biological life, in particular the phyto and Zoo plankton and fish life, in river Daha (N. Bihar) have been studied.

131. DE (SB) and RADHAKRISHNAN (I). An unusual pollution of water in kidderpore docks, Calcutta. J. Instn. Engrs. India. 46, 6; 1966; 53-6.

Analysis carried out with samples of polluted water collected over a month at the docks is presented. The pollution is attributed to the ingress of cane sugar. Even by adopting measures like Chlorination and aeration combined with the diln. afforded by the make-up water and the atmospheric reaeration, it is found that it takes nearly one month for cleaning up of such gross pollution.

132. GUPTA (SD). Problem of industrial waste treatment of wastes from sugar factories. Proc. a Conv. Sugar Technol. Ass. India. 33, 2; 1965; 59-67.

The two biological methods, viz. aerobic treatment by bio-filtration, and anaerobic digestion by lagooning of treatment the effluents of sugar factories have been tried on pilot plant and on factory scale. The practical problems encountered in adopting these methods have been described.

133. GUPTA (SD). Treatment of distillery effluent by anaerobic digestion. Proc. a Conv. Sugar Technol. Ass. India. 33, 2; 1965; 69-72.

Anaerobic digestion of distillery effluent is being tried on a pilot plant scale at the Hindustan Sugar Mills distillery at Golagokarannath. BOD of the spent wash which ranges from 77000 to 47000 ppm is reduced to about 3000 to 2600ppm in the digester. This is further reduced to 1000 to 1500ppm in the activated sludge. The reduction of BOD to the desired limit, 500 ppm, is achieved by diluting the discharged effluent with distillery water.

134. PARASHAR (DR). Treatment of sugar factory effluents in relation to the tolerance limit of biochemical oxygen

demand. ***Indian Sug.*** *18, 12; 1969; 879-85.*

The merits of different processes in relation to the tolerance limits of BOD fixed by different authorities are discussed.

135. PARTHASARTHY (T) etc. Anaerobic stabilization of distillery waste from cane sugar industry. ***Envir.Hlth.*** *9, 2; 1967; 110-7.*

Detailed lab. investigations were carried out to determine optimum conditions of operation under which anaerobic digestion of distillery waste could be done. Pilot plant study at the factory site has been proposed to verify the results of the lab. studies.

136. QASIM (SZ) and SIDDIQI (RH). Preliminary observation on the river Kali Caused by the effluents of Industrial wastes. ***Current Science.*** *29,; 1960; 310-11.*

The effluent of animportant sugar mill is being discharged revealed the problem to be more acute than it had been anticipated. The conditions prevalent in the river at that place seemed for from being satisfactory. The colour of the river water was markedly brown with a turbidity 55-70 p.p.m. and in close vicinity of the out fall of the effluent; it gave a strong unpleasent oduour. The pH ranged from 6.2 to 7.7 with in one mile up stream of the outfall; D.O; 1.5 to 4 ppm. and BOD on an average 10 ppm.

137. SINHA (SN) and THAKUR (B). Anaerobic digestion of cane sugar waste. ***Envir. Hlth.*** *9, 2; 1967; 118-25.*

Anaerobic digestion of composite samples of effluents from different sugar factories working with different processes of production of sugar was studied. The bacteria for anaerobic digestion were obtained from *actively digesting sewage sludge. They were acclimatized with the waste by gradual feeding. In the four series of experiments, stable effluents were obtained after digestion and their pH values were always found towards alkaline side. An optimum period of digestion for the waste waters was two days.*

138. *VERMA (SR) etc. Studies on sugar factories and their wastes in western Uttar Pradesh. Indian J. Environ. Hlth. 20, 3; 1978; 204-18.*

The present study, deals with the survey of 25 sugar factories waste in western Uttar Pradesh. It has been found that these factories are creating a serious problem of water pollution and insanitary conditions in the region where they are situated. Suggestions have been made to check the volume of wastes and for treatment of the waste water before its release to an out side waste water system.

139. *VERMA (SR) and SHUKLA (GR). Pollution in a perennial stream 'Khala' by the sugar factory effluent near Laksar, U.P., India. Envir.Hlth. 11, 2; 1969; 145-62.*

Ecological character of stream polluted by sugar factory effluent has been discussed. It was found that pollution affects the distribution of fishes, plankton and alters the bottom biota of the stream to a great extent construction of settling tanks and use of biological or chemical method for effluent treatment has been recommended.

INDUSTRIAL WASTE, SULPHITE INDUSTRY, RIVER POLLUTION.

140. *VASSEUR (E). Progress in sulfite Pulp pollution abadement in Sweden. Jour. Water Poll. Control Fed. 36,*

Water pollution caused by sulfite pulp mills have been counteracted by reclaiming most of the spent sulfite liquor and using it to produce alcohol or for use as a fuel. In many cases the change to sodium or magnesium base has given further improvement. Lagoons, river aeration and marine biological treatment is employed only when all other control measures fail.

141. WALDICHUK (M). Effect of sulfite wastes in a partially enclosed marine system in British Columbia. <u>Jour. Water Poll. Control Fed</u>. 38, 9; 1966; 1484-1505.

Sulfite mill wastes discharged into the inner basin of a series of shallow marine embayments in British Columbia depresses the DO by as much as 8 mg/l. The flux of DO is close to the daily oxygen demand of the mill wastes. DO was restored to normal concentration during a week of mill shut down and declined after resumption of production. A BOD loading of 14% of that imposed in July 1962 would allow adequate DO for fish life.

<u>INDUSTRIAL WASTE, SYNTHETIC INDUSTRY, RIVER POLLUTION</u>.

142. MOHAN RAO (CJ) etc. Waste treatment at a synthetic drug Factory in India. <u>Jour. Wat. Poll. Control Fed</u>. 42, 8(pt 1); 1970; 1529-44.

A factory at Hydrabad, India designed to produce synthetic drugs, vitamins and organic intermediates was expected to discharge 600 cu m/day of liquid wastes contain in g a large number of organic and inorganic chemicals. Wastes from other blocks containing toxic organics in solution, could be treated biologically by acclimatised sludge when diluted with concentrations up to 7%.

143. SUBBA RAO (B) etc. Anaerobic activated sludge process. Indian J. Environ Hlth. 13, 4; 1971; 285-90.

The possibility of treating domestic sewage (synthetic waste) was studied. The initial substance concn. was maintained at 500-520 mg/l in terms of COD. The detention period was varied along with organic laging. It is found that an organic laoding of 0.5 kg/cum/day is optimum at detention time of 1 day giving a COD reduction of 83%. The results at other loadings are also reported.

INDUSTRIAL WASTE, SURGICAL INSTRUMENTS INDUSTRY, RIVER POLLUTION.

144. SREENIVASAN (A) etc. Effect of wastes from a surgical instruments factory on Adyar river (Madras), India. Indian J. Environ. Hlth. 13, 3; 1971; 220-5.

It was found that the wastes from surgical instruments manufacture are treatable by combining with domestic sewage and the resulting effluent was not toxic to fish and other biota. The oxidation pond from which the effluent percolates into the river supported phyto and Zoo plankton production.

INDUSTRIAL WASTE, TANNING INDUSTRY, RIVER POLLUTION.

145. CHAKRABARTI (R N) etc. Primary treatment of tannery wastes - a laboratory and field study at Kanpur. Envir. Hlth. 9, 2; 1967; 162-71.

Presents the results of treatment of tannery wastes done at the laboratory level as well as the full scale treatment plants. The sludge thus obtained was tested for its manural values. Dried sludge in respect of its N values on dry wt. bases proved better manure than farmyard manure and is comparable to wool waste, poultry manure and trickling filter manure.

146. MADHAVAKRISHNA (W) etc. Standardisation of a trickling filter process for the pilot plant treatment of tannery effluents. Tanner. 22, 7; 1967; 247-50.

The conditions for the biological treatment of tannery effluents in a pilot plant trickling filter were standardised making use of different mixtures of sewage and effluents, as well as mixture of vegetable t an liquor or chrome liquor along with suitable proportions of beam house liquors. Both in case of vegetable tan liquor mixt. and chrome tan liqor mixt. abotu 93% reduction in BOD was observed.

147. MAX (E) and BANJAMIN (RE). Tannery effluent treatment a cost benefit analysis. Leath Sci. 22, 10; 1975; 305-10;

A procedure for determining the optimal methods of treatment of tannery effluents is suggested.

148. THAMBIANNAN (CP) and MEENAKSHISUNDARAM (TK). Conditioning tannery waste for biological treatment. J. Instn. Engrs. India. 45, 10; 1965; 86-93.

The effect of sewage in conditioning tannery wastes for biological treatment, was studied by the public Health Engineering Dep. of the College of Engg., Guindy using two small scale trickling filter units. The wastes were obtained from the vegetable tanning yard of Madras, and the sewage from the pumping in the College campus. It was found that the toxic tannery waste, if mixed with sewage in suitable proportions, can be properly treated in a trickling filter. For the waste having a BOD value of approx. 3000 p.p.m., the tannery waste to sewage ratio of 1:30 gave a final effluent from the trickling filter having a BOD value of 59 p.p.m.

INDUSTRIAL WASTE, TEXTILE INDUSTRY, RIVER POLLUTION.

149. GANAPATI (SV). In-plant process control for abadement of pollution load of textile wastes. Envir. Hlth. 8, 3; 1966; 169-73.

Abadement of pollution in the wastes in some of the processes connected with preparations for weaving and dyeing and finishing is discussed.

150. GOVENDAN (VS) and SUNDARALINGAM (VS). Treatment of textile mill waste water by stabilization pond method. Indian J. Environ.Hlth. 21, 4; 1979; 321-31.

This study shows that textile mill waste water can be treated by mixing with sewage in the proportion (1:5) by waste stabilization pond with a detention time of 8-12 days and using acclimatised algae culture at a BOD loading of 200 kg per hectare per day.

151. KOTHANDARAMAN (V) etc. Performance of oxidation ponds at Ahmedabad. Envir.Hlth. 10, 2; 1968; 135-48.

Working of oxidation ponds treating sewage mixed with textile wastes in the ratio of 3:1 has been studied for their performance biochemical oxygen demand loading, BOD removal, retention time etc. It has been found that ponds can work out efficiently at the highest BOD loads of 728 lb/acre/day giving out 77.5% BOD removal and with a very low detention time of 2.4 days.

152. LITTLE (AH). Modern methods of effluent disposal. Colourage. 23, 15A; 1976; 26-31.

Deals with textile effluents, their character and their effects on the environment, together with water supplies and usage.

153. SOUTHER (RH) and ALSPAUGH (TA). Biological treatment of mixtures of textile wastes and domestic sewage. Sew. & Ind. Wastes. 28, 2; 1956; 166-76.

The paper discusses pilot plant treatment of highly alkaline mill waste and domestic sewage mixtures. Textile mill waste including sulpher dye sewage waste can be satisfactorily treated by the activated sludge or trickling filter process.

154. VERMA (SR) etc. Characteristics and disposal of industrial effluents with reference to ISI standards : Part II. Indian J. Environ.Hlth. 19, 3; 1977; 165-75.

Characteristics of wastes from textile mill, fertiliser and antibiotic factories, distillery and slaughter houses in Uttar Pradesh and their disposal according to requirements of ISI standards were studied. It is suggested that the wastes should be treated chemically or biologically to the extent suggested by I.S.I. before being discharged into rivers, sewage system or on land.

155. VERMA (SR) etc. Toxicity of textile waste to some teleost fishes. Water Air, Soil pollution. 10, 3; 1978; 351-7.

Medium lethal concentration values for different peirods, acute toxicity ranges and presumably harmless concentrations, along with relative susceptibility of a few fresh water teleost fish to textile waste were determined. The presumably harmless concn. to regulate the disposal of this waste was 1.1254, 0.4966, 0.9912, 1.0157 and 1.086% by vol. for saccobranchus, fossilis, labeorohita, Notopterus, colisa fasciatus and ophiocephalus punctatus respectively.

INDUSTRIAL WASTE, TEXTILE-LEATHER-PAPER INDUSTRY, WATER POLLUTION.

156. *MANAS CHANDA. Water pollution-textile, leather and paper industry wastes. Indian Chem. Mfr. 14, 3; 1976; 5-12.*

The characteristics and treatment methods that can be adopted in India for the above wastes are discussed.

INDISTRIAL WASTE, UREA INDUSTRY, RIVER POLLUTION.

157. *GUPTA (SK) etc. Treatment of nitrogenous fertilizer waste by flocculating algal-bacterial system. Indian J. Environ.Hlth. 21, 2; 1979; 105-12.*

Nitrogenous fertilizer indistries manufacturing urea discharge a considerable amount of urea alongwith ammonia in their waste. The heavy dose of urea in the effluent causes ill effects to aquatic life and entrophication. The problem can be solved by treating the waste by a flocculating algal-bacterial system under natural condtions. In this system, a fraction of nitrogen and other nutrients are converted into an easily sttleable biomass. The other fraction will be hydrolysed to ammonia by urea hydrolysing bacteria and other micro-organisms.

158. *JAIN (AK) etc. Water pollution and its abadement in urea plant. Chem.Age India. 28, 6; 1977; 493-6.*

Deals with the removal of ammonia nitrogen and urea nitrogen from the waste stream. The effect of pH lime of aeration and temperature has been studied. The effect of PH for the removal of ammonia, nitrogen and urea, nitrogen has been found to be 12.1. The optimum time of aeration for max. removal is 30 hrs. Max. removal of COD was observed at 12.6 pH BOD after 5 days was max.at 30°C.

INDUSTRIAL WASTE, VANASPATI INDUSTRY, RIVER POLLUTION.

159. *BASU (AK). Treatment of effluents from the manufacture of soap and hydrogenated vegetable oil. J. Wat. Pollut. Control Fed. 39, 10; 1967; 1653-8.*

A well-blended combined waste from a vanaspati factory was treated on the lab. scale. Of the methods attempted coagulation followed by 30 min. sedimentation and anaerobic digestion with sewage sludge seed were found suitable. The important observations made are presented.

160. *CHAKRABARTY (RN) and TRIVEDI (RC). Anaerobic digestion of spent vegetable tan liquor. Environ. Hlth. 7, 3; 1965; 135-42.*

Experiments on anaerobic digestion of spent vegetable tan liquor showed that the waste could be anaerobically digested at 37°C using cow manure as seed at a volatile solids loading of 0.054 lb/day/cu.ft. digestion tank capacity, corresponding to a detention period of 32 days. The study indicates that the spent tan liquor can be segregated and pretreated by anaerobic digastion so as to simplify further aerobic treatment of the mixed tannery effluents by prior removal of bulk of their BOD and maintaining the BOD/N ratio to an optimum value.

161. *KADAM (RV) and VASHI (NV). Treatment of waste water from a factory manufacturing vanaspati : A case study. IAWPC Tech. Annual pollution Control. 5; 1978; 69-77.*

It discusses the various aspects of treatment of waste waters from the factory basically manufacturing vanaspati of about 5 hundred tonnesper annum and other by products like soap etc. The waste water generated during the refinery process, mainly contains oil and soap products, suphates, chlorides and BOD exerting materials. For its efficient and economical treatment, chemical treatment with lime & Ferrous Sulphate can be adopted. It comprises of a flash mixer, Flocculator and clarified unit. The chemically treated waste can then be further treated biologically by extended aeration type activated sludge process. Final clarification will be helpful in separating out the biological sludge. The drying of excess sludge cnn be achieved by sludge drying beds.

INDUSTRIAL WASTE, VISCOSE RAYON INDUSTRY, RIVER POLLUTION.

162. BHAKUNI (TS) and BOPARDIKAR (MV). Recovery of zinc from spinning bath waste of a viscose rayon factory by ion-exchange process. Envir. Hlth. 9, 4; 1967; 327-38.

Laboratory study for recovering zinc by adsorption on cation exchange resin (H-Cycle) has been reported. An indigenously developed polystyrene based cation exchange resin could absorb zinc from a waste sample to the extent of 5 to 6 kg/cu.ft. of the resin. Zinc could be eluted from, the resin by the stronger waste or a fresh solution of 7-8% sulphuric acid. It was found to be quite suitable for prepairing for fresh bath.

163. CHAKRABARTY (RN) and SAXENA (KL). Industrial waste survey report III. Studies on viscose rayon wastes. Envir. Hlth. 8, 2; 1966; 112-22.

A survey was carried out to assess the source, quantity and quality of Viscose rayon wastes. An inplant survey was followed by flow measurement, sampling and analysis of the individual and the total waste waters of the J.K. Rayon Ltd., at Kanpur. The results are discussed.

INDUSTRIAL WASTE, RIVER POLLUTION.

CHATURVEDI
164. ~~Chaturvedi~~ (AC). Industrialization and river ecology. J.Instn.Engrs. India. 58, 2; 38-41.

The increasing urban population in India has affected the river system through increased industrialization and altered land use and drainage patterns. The U.P. irrigation commission investigated the problems of pollution, industrialization, river ecology, erosion, vegetation and climate.

INDUSTRIAL WASTE, RIVER POLLUTION, ADYAR.

165. SUNDARESAN (BB). Stream capacity constants of Adyar river. J.Instn. Engrs India. 45, 10; 1965; 77-85.

The pollution of Adyar river, Madras, and its capacity for self purification has been studied, sampling stations were established along a 8¼ mile stretch of the river and the quality of water based on chemical, bacteriological and biological analysis was determined weekly for 5 months. The experimental data were used to evaluate the stream capacity constants. The values of these constants were found to vary depending upon the conditions prevailing at the different sampling point along the course of the river.

INDUSTRIAL WASTE, RIVER POLLUTION, DAMODAR.

166. SHARAD KUMAR and VISHWANATHAN (K). River survey of pollution of Damodar waters. Chem. Ind. Dev. 11, 5; 1977; 30-2.

The extent of pollution of the Damodar river on account of various industries at its bank has been indicated.

INDUSTRIAL WASTE, RIVER POLLUTION, GANGES.

167. AGARWAL (DK) etc. Bacteriological study of Ganges water at Varansi. Indian J.Med.Res. 64, 3; 1976. 373-83.

Sixty one samples from bathing ghats and 12 from sewage out falls were studied. At the bathing ghats the mean MPN index/100 ml.was 9.219 X $10^3 \pm$ 3.178, and the mean value of fecal uniforms was 4.598 X 10^3 ± 2.487/100 ml. The mean increased manifolds at the sewage out falls (MPN index 152.4000X10^3/100 ml. and fecal coliform 128.4 X 10^3/100 ml. Pathogenic intenstinal bacteria like Vibrio Cholerae, salmonella and Shigellae were isolated both from the ghats and sewage out falls.

168. SEHGAL (JR) and SIDDIQUI (RH). Characterization of waste water from Kanpur City. Envir.Hlth. 11, 2; 1969; 95-107.

A characterization study of Kanpur city waste water was conducted to evaluate design criteria for waste management programme. Percapita contribution of various constituents of the waste is reported along with the industrial contribution. Further-more, it is concluded that the present system of disposal of waste by irrigation and dilution in river Ganges may create nuisance conditions in the river during low flow.

INDUSTRIAL WASTE, RIVER POLLUTION, FOX, GREENBAY, LAKE MICHIGAN.

169. HOWMILLER (RP) and BEETON (AM). Biological evaluation of environmental quality, Green.Bay, Lake Michigan. Jour. Water Poll. Control Fed. 43, 1; 1971; 123-33.

A comparison of the benthic invertebrates found in samples from Green Bay, Lake Michigan, taken at the same stations in May 1952 and May 1969, showed marked changes. The entrophic and pollution-tolerant groups Oligochaeta and Chironomidae increased in abundance over most of the bay. Most other benthic invertebrates were less abundant in 1969 than in 1952, suggesting that deterioration of the bay environment had increased. The major pollution source is the Fox,river. An abiotic area exists around the river mouth.

INDUSTRIAL WASTE, RIVER POLLUTION, HOOGHLY, MATLAH.

170. BASU (AK) etc. Comparison of the polluted Hooghly estuary with the unpolluted Matlah estuary. Jour. Water Poll.Control Fed. 42, 10; 1970; 1771-81.

The study revealed that the general condition of the Hooghly with respect to biochemical oxygen demand, oxygen consumed value and temperature was inferior to that of Matlah. Turbidity was higher in the Hooghly, where as pH, nitrite nitrogen and free ammonia values were similar at mid stream in both estuaries. The Hooghly had fewer plankton than the Matlah, and physicochemical conditions around some discharge points in the Hooghly were unfavourable for fish life.

INDUSTRIAL WASTE, RIVER POLLUTION, KLAMATH.

171. MASON (WT) etc. Artificial substrate sampling, macro invertebrates in a polluted reach of the klamath river, Oregon. Jour. Water Poll. Control Fed. 42, 8(pt 2), 1970; R315-28.

Macro invertebrates were collected with rock-filled artificial substrate samlers at five stations in a 48 Km. reach of the Klamath river, Oregon, during 1965-66. The reach of stream is between the upper Klamath Lake and a reservoir. Enriched water the lake, wastes draining from the city of Klamath Falls, industrial wastes and irrigation return water all contribute to the pollution of the river. At none of the stations the water considered "clean".

INDUSTRIAL WASTE, RIVER POLLUTION, PANDU.

172. GUPTA (DC) and PANDEY (GC). Environmental pollution monitoring of river Pandu at Kanpur. J.Inst.Engr.India. 60, 2; 1980, 42-5.

An environmental pollution survey of river Pandu at Kanpur was carried out during 1977-78. Ten different sampling points were considered for the physico chemical analysis of receiving water, It was found that most of the parameters conform to the standards except at a few sampling points where relatively higher concentration of pollutions was observed.

INDUSTRIAL WASTE, RIVER POLLUTION, PRISTINE.

173. WOLMAN (MG). The nations' rivers. Jour. Water Poll. Control Fed. 44, 5; 1972; 715-37.

Various parameters of pollution in the nation's rivers are examined through analysis of data from studies made over long periods of time. Variables examined are dissolved oxygen, dissolved solids, sediments, temperature, radio activity, pesticides and trash and debris. Greater emphasis must be placed on the study of pristine waters to understand the nature of initial changes of pollution and on the study of large rivers with clean up progrmas where indications are that pollution is reversible.

INDUSTRIAL WASTE, RIVER POLLUTION, TIGRIS.

174. MAHMOUD (TA) etc. Pollution in the Tigris river due to raw waste water from multi-out falls near Mosul. J.Instn.Engrs.India. 59, En2; 1979; 50-4.

The effect of the discharge of raw waste water, both domestic and and industrial upon the Tigris river has been evaluated to present an over all picture of the status of pollution in the river. River water sampling was done at 45 sections, along the 18 Km. strip of the river, to find dissolved oxygen and BOD in the river water. The data have been analyzed and the extent of pollution ascertained. The river water quality in general, was determined and compared with values reported in the literature.

INDUSTRIAL WASTE, RIVER POLLUTION, YAMUNA.

175. *BALANI (MC) And SARKAR (HL). Some observations on the pollution of Yamuna river at Okhla water works Intake, Delhi. Environ.Hlth. 7, 2; 1965; 84-6.*

Pollution in Yamuna river near the water supply intake at Okhla water works, Delhi, has been studied during the monsoon period 1960-61. It is suggested that the water supplies be regularly monitored for content of free ammonia which may be useful in fixing the criteria of pollution of drinking water supply.

176. *BULUSU (KR) and SHARMA (VP). Survey of Najafgarh drain down stream of industrial area. Envir.Hlth. 8, 2; 1966; 103-11.*

The Najafgarh drain carrying a mixture of accumulated flood water, Sullage and industrial wastes discharges into river Yamuna down stream of Wazirabad Barrage. The drain and the river were surveyed eleven times when the flow through drain and the river was low and the results are discussed. It is concluded that the various chemical characteristics investigated were well with in the permissible limits down stream of confluence point and hence the drain does not render the river unsuitable during summer season.

177. *DAKSHINI (KMM) and SONI (JK). Water quality of sewage drains entering Yamuna in Delhi. Indian J. Environ.Hlth.*

21, 4; 1979; 354-60.

In this paper the data on phytoplankton distribution and physico-chemical characteristics of water of two sewage drains entering the river Yamuna in Delhi is presented of the total 32 genera of phytoplanktons recorded, 31 were present in Najafgarh drain and 10 in Rajghat drain.

178. KUNDRA (RK) etc. Raw Water quality at Wazirabad and Okhla reservaoirs in Delhi. Indian J. Environ. Hlth. 19, 4; 1977; 329-39.

Chemical and bacteriological examination of water from both the reservoirs show that the water quality at Wazirabad is comparatively better than that at Okhla. The high Coliform count and increase in the concentration of ammonia, chloride, oxygen absorved values etc. Clearly show that the rivergets progressively polluted as it flows the city.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASUREMENT.

179. ARCEIVALA (SJ). Regulations for discharge of industrial wastes into municipal sewers-a model bye-law. Envir. Hlth. 7, 1; 1965; 1-16.

A model bye-law has been presented which gives a ready basis for framing a bye-law to suit the needs of any particular municipality or public body. Information provided in the paper will be useful for the public officials who have to deal with individual cases in the absence of a detailed bye-law.

180. BENTRA (JK) etc. Reduction of micro-organisms at different stages of water treatment. Envir. Hlth. 9, 2; 1967; 142-50.

A study was conducted to evaluate the effectiveness of various water treatment processes as measured in terms of reduction in micro organism. viz. coliform, enterococcus and phytoplankton. 147 observations were made from samples from chandrawal water works and 27 observations from Okhla water works.

181. BISHNOI (C P). Problem of pollution in water ways. J. Instn. Engrs. India 49, 2; 1969; 68-75.

The major issues involved in controlling pollution, the better known pollutants, their origin and characteristics, their action on receiving water and alternative methods available to treat the wastes are summarized.

Chandrasekara

182. ~~CHANDRASEKARA~~ CHETTY (KVR). Some aspects of salt water intrusion of rivers in Goa and their utility. Indian J. Environ.Hlth. 19, 3; 1977; 210-23.

The problem of salt water intrusion is significant in non-utilisation of surface water of these rivers located in the adjoining and in-between areas. For an effective control over the problem, it is necessary to set up a technical organisation with a well equipped laboratory and administrative machinery which would go a long way to mobolise fully the natural resources of the area and its adjoining Coastal territory and will ultimately accelrate the economic upliftment of the region as a whole.

183. LABELLI (C) etc. The industrial wastes control programme in New York City. Jour. Water Poll. Control Fed. 40, 12; 1968; 1981-2012.

New York City's enactment of a local law for the control of industrial waste discharges to the sewer system is unique because of the variety of manufactueres and service-type industries involved. Results of pilot studies using new techniques and description of several unique waste problems, sampling methods and equipment used are included.

184. PRABHUDESAI (MK). Monitoring industrial waste water. Chem. Age India. 27, 11; 1976; 941-3.

Describes some of the instruments that may be useful in monitoring programmes for industrial waste water.

185. RANGANATHAN (GS). Industrial water treatment. Chem. Era. 11, 5; 1975; 11-5.

Tabulates recommended water treatment based on the use. Out lines processes for treatment. Discusses briefly on the equipment, quality consciousness and the development of water treatment industry in India.

186. RAO (HS) and AHLUVALIA (JS). Industrial wastes, pollution control and analytical instrumentation. Indian Mfr. 18, 6; 1977; 8 pp.

Discusses recent advances in analytical instrumentation and illustrates how some typical pollutants can be analysed in concentrations as low as parts per billion levels The integration and coordination of the different techniques are critically reviewed and the most suitable method for the detection and estimation of specific pollutants in industrial effluents and the environment is reported.

187. SHRIVASTAVA (SK) and KAUSHIK (NK). Certain aspects of pollution and purification in Agra Canal. Environ.Hlth. 8, 2; 1966; 123-33.

Agra Canal receives discharge of sullage and partially treated sewage. Though these discharges up set the initial oxtgen balance of the Canal, it starts regaining it snatural andition about 82 min. after receiving discharge of partially treated sewage. Reaeration Coeff. velocity of flow and mean depth of water show good correction.

188. *THAKUR (UC) and DESHPANDE (WM). Problem of industrial wastes disposal in Bihar vis-a-vis the available water resources. Indian J. Envir. Hlth. 18, 2; 1976; 138-48.*

The problem of industrial wastes disposal in Bihar has been reviewed. The pollution load and the water quality available in rivers due to indiscriminate discharge of wastes have been presented. Measures adopted for abadement of pollution have been brought out. Some suggestions for a more realistic approach to river pollution control have also been given.

189. *VASISHT (HS) and SRA (GS). Self-purification in Chandigarh waste waters. Indian J. Ecol. 3, 1; 1976; 7-10.*

Self purification potential of a polluted nulla at Chandigarh was investigated. It has been observed that in the flowing water upto 15 Km., there occurs with the distance a change in physico-chemical factorse e.g. temperature, pH, DO, B.C.D., Suspended solids, hardness, alkalinity nutrients. The biological degradation is brought about by agents, such as protozoans, nematodes, rotifers, insect, algae and diatoms. As the nulla flows downwards, ecological conditions improve, they in turn increase the diversity and number of organisms-a tendency towards self-purification.

190. *VERMA (RD). Planning of industrial waste water treatment systems. J.Instn.Engrs.India. 57, 1; 1976; 40-3.*

A methodology of scientific planning of the industrial waste water treatment systems has been presented. Regularly requirements, data collection, implant alternatives, pilot plant studies and conceptual design of industrial waste water treatment systems have been discussed. Certain solutions to the problems of industrial waste water pollution in India have been suggested.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASURMENT, BUFFALO.

191. SYMONS (George E) etc. Industrial waste Pollution abadement programe for Buffalo, New York. Sew. Works Jour. 20, 5; 1948; 861-71.

Following studies of the stream pollution of the Buffalo river at Buffalo, N.Y., certain recommendations were made for abating the pollution of that stream. Definite progress has been made and indications are that the implementation of that problem may become afact although there are still obstacles to overcome.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASURMENT, GOMATI.

192. BHASKARAN (TR) etc. Studies on river pollution. 1. Pollution and self purification of Gomati river near Lucknow, J. Instn. Engrs India. 45, 6; 1965; 39-50.

To study the pollution of the Gomati in Lucknow region which has increased considerably in the recent year, a survey was carried out in the Lucknow region for:1) determining the extent of pollution of the extent of pollution of the waters in different season; 2) the capacity to assimilate pollution; and 3) to work out suitable remedial measures for the abatement of pollution in the Lucknow region. The results of the ivestigations are presented.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASURMENT, MISSISSIPI.

193. BACON (VW) and DALTON (FE). Professionalism and water pollution control in Greater Chicago. Jour. Water Poll. Control Fed. 40, 9; 1968; 1586-1600.

The metropolitan sanitary district of Greater Chicago, formed in 1889 has succesfully kept pollution from the *area's water supply and water recreation areas. The initial phase involved construction of Canals to convey wastes over a low divide away from Lake Michigan to tributaries of the Mississipi river system. The need for lessening pollution in these channels led to construction of waste water treatment plants.*

INDUSTRIAL WASTE, RIVER POLLUTION, MEASURMENT, VAITARNA.

194. *DHAYAGUDE (LG) and MIRCHANDANI (NW). Characteristics and treatment of vaitarna lake waters. J. Istn. Engrs. India. 48, 2; 1967; 21-43.*

Various studies as regards the charecteristics of water, chemical doses required, the clarifier loadings and filtration velocities are made to determine the most economical design criteria of the main treatment plant rated capacity of 490 mega - litres per day. Some of the studies made and the conclusions arrived at are presented briefly.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASURMENT, BIOLOGICAL.

195. *JOHN (U Lazar) and BOKIL (SD). Floculating Algal-bacterial system - A new method of waste water treatment. Indian J. Envıron. Hlth. 21, 1; 1979; 1-9.*

This paper describes a low cost method for treating waste water by utilising an algal-bacterial system. This study at IIT, Kanpur revealed that the system is capable of removing about 80% of COD, 65% of N and about 75% of P from domestic waste water. The optimum ratio of algae to bacteria for flocculation to take place is 60:40. A detention time of 6-8 hours is the most optimum.

196. *REKHASARKAR and KRISNAMOORTHI (KP). Biological methods for monitoring water pollution levels : studies at Nagpur. Indian J. Environ Hlth. 19, 2; 1977; 132-9.*

Studies were carried out for evaluating ecological and chemical parameters of fresh water and polluted water sources. The sources were classified on the basis of quality and quantity of fauna present alongwith the complimentary chemical parameters. The observations were confirmed by conducting autoecological experiments. Various systems of biological monitoring have been discussed.

<u>INDUSTRIAL WASTE, RIVER POLLUTION, MEASURMENT, CHEMICAL</u>.

197. ADHIKARI (M) etc. Acidified alum sludge and fly-ash as adjunt to coagulation. <u>J. Indian Chem</u>. Soc. 52, 2; 1975; 127-30.

Alum sludge (aging less than one hour) and flyash after treatment with sulphuric acid and phosphoric acid separately could be used as adjunts to coagulation in Municipal Water treatment. Those were found to be efficient in reducing the actual alum requirment. Sulphoric acid treated sludge was broved to be most effective adjunct, specially in the higher turbidity range. These also possessed the capability of diminishing the coliform count in supply water and initiated flocculation of both phyto and zooplanktons usually present in river water.

198. ADHIKARI (M) etc. Study of sodium Aluminate in conjunction with Alun for coagulation of red water of the Ganges. <u>J. Indian Chem. Soc</u>. 51, 10; 1974; 891-4.

Red water in the Ganges river possesses a problem in coagulation, requiring excessive alum. The resistance to coagulation is possibly due to fineness of a Collidol particle. The application of sodium aluminate along with basic alum is found to be a better combination for efficient coagulation possibly due to enhanced hydrolysis of alum in presence of sodium aluminate and increased sorption of hydrolysed alum by clay particles.

199. *BHOLE (AG). Chemical treatment of waste water. <u>IAWPC Tech. Annual</u>. 5; 1978; 85-108.*

The chemical treatment overcomes the short comings of biological treatment and achieves higher standards for effluents, it has wide scope and application for sewage and industrial waste treatment in near future. The only disadvantage of chemical treatment is the production of large volume of sludge. The process of flocculation not only removes inorganic compounds and particulate solid material efficiently but also removes colour, soluble organic compounds, toxic substances and heavy metals too. The process also removes bacteria and viruses with a high degree of efficiency.

200. *BOKIL (SD). Use of aerated lagoonsin waste treatment. <u>J. Scient. ind. Res</u>. 35, 2; 1976; 103-9.*

The process design and operation of aerated lagoons in the treatment of liquid wastes are discussed. The state of knowledge in this area is considered from the point of view of functions, kinetics, biological parameters, power and mixing characteristics and maintenance of aerated lagoons. The scope of the use of aerated lagoons in India is discussed.

201. *KAUL (SN) and RAMAN (V). Rationalisation of mixing and aeration operations in waste water. <u>Indian J. Envir. Hlth</u>. 18, 2; 1976; 123-37.*

In sewage treatment mostly aerobic microorganisms are used to degrade domestic or industrial wastes. Sewage provides food material to the microorganisms and oxygen is supplied externally either through bubbling compressed air or by surface aerator. Mixing ensures uniform conditions of temperature, composition of the sewage ingredients, concentration of microorganisms and oxygen and a rapid rate of metabolism.

202. *KHAN (AN) and SIDDIQI (RH). Waste water treatment by anaerobic contact filter. Indian J. Envir. Hlth. 18, 4; 1976; 282-91.*

A laboratory unit of Anaerobic contact filter was operated to investigate its performance. The anaerobic contact filter is an upflow filter where the waste is introduced from the bottom and the filter is submerged completely. The bacterial growth is retained on the stone media making possible higher loading rates. Such filters may provide simple and low cost treatment of waste waters.

203. *KHANNA (PK) and TOSHNIWAL (CL). Removal of turbidity, algae and bacteria in coagulation of prechlorinated water. J. Instn. Engrs. India. 48, 3; 1968; 183-96.*

The nature and extent of the effect of chlorine application on the removal of turbidity and bacteria of algae laiden waters is discussed. Alum, jar test and chlorination have been employed for coagulation, clocculation and pretreatment. Bacteria removal was generally high. Both the percentage turbidity removal and percentage algae removals fiest increased and then decreased with the increase of alum dose. Chlorine application neither consistntly nor significantly affects the optimum removal.

204. *MARIAPPAN (M). Disinfection of waste water effluent by chlorination. Indian J. Environ. Hlth. 21, 2; 1979; 113-9.*

The paper describes the purpose and effectiveness of chlorine as a disinfectant in the area of waste water treatment. Chlorination of sewage is extensively practised in Europe and USA in order to comply with existing acts on pollution control. Aside from disinfection, the negative effects of chlorination result due to the formation of chloro-organics some of which are carinogenic. The paper also discusses the utility of the mathematical model developed by EPA regional centre in the state of Illinois, USA, for estimating the degree of disinfection by chlorine.

205. MEHTA (RS) etc. Use of Chlorine in sanitary engineering practice. Indian J. Engrs. 5, 4; 1964; 13-28.

Application of Chlorine in the treatment of drinking water, domestic waste water, industrial waste and its use in conjunction with industrial water has been reviewed.

206. PANDIT (RK). Starch as a coagulant aid in water treatment. Environ.Hlth. 7, 1; 1965; 39-43.

The use of starch, and to some extent, other polysaccharides as coagulant aids is limited. They can be used in low dosage and in very narrow margin. If used with alkali, the effects will depend on the alkali contents and pH. The use of coustic starch has the additional advantage of rendering the water non corrosive.

207. PAREEK (Narendra K). Oxygen activated sludge process-state-of the Art. IAWPC Tech. Annual. 5; 1978; 17-31.

The oxygen activated sludge system has already claimed its place in waste water treatment. The oxygen system maintains high DO levels in mixed liquid generally 4 to 6 mg/l as against 1 to 2 mg/l in air activated sludge system. This system may come through as a potential treatment facility for concentrated biological waste waters. This system is compact and may suit the locations where space is a limitation. The development of technology for cheap and bulk separation of oxygen from air, which presently accounts for higher operations costs may boost the use of this system. The process stability observed in oxygen system, may provide additional charm for industrial waste treatment.

208. PRABHU (PV) etc. Chitosan as a water clarifying agent. Fishery Technol. 13, 1; 1976; 69-72.

Use of chitosan as a water clarifying agent is described. Treatment with chitosan is found to bring down the bacterial load of the contaminated water during clarification. Chitosan has the property of bringing down the bacterial load in water by coagulating and dedimenting the bacteria along with other suspended particles. The application is simple and the time taken for clarification is short.

209\. *SASTRY (CA) and ABoo (KM). Treatment of strawboard wastes by activated sludge process.* _Envir.Hlth._ *11, 2; 1969; 136-44.*

Experiments were carried out to study the possibility of treating settled strawboard waste in admixture with sewage by activated sludge process. Prior to the collection of data, activated sludge was acclimatised to settled strawbaord waste to avoid lag period in the removal of BOD in the system. Data collected on the various parameters showed that a steady growth of sludge occured since the begining of the aeration period and the volatile matter in sludge increased from 62-84% with in a period of 30 days.

210\. *SINGH (RC). Cyclic coagulation- a new concept on water treatment.* _J. Instn. Engrs. India._ *56, 2; 1976; 76-9.*

In water coagulation considerable quantities of costly chemicals are used which turn into sludge creating a disposal problem. The use of magnesium carbonate as coagulant and its recovery by a simple and inexpensive method presents an ideal solution that uses no chemicals and produces no waste sludge. The system is simple, economical and has many inherent benefits. If widely adopted, it can considerably reduce the cost of water treatment in India.

211\. *SRINIVASAN (TK) etc. Studies on raw water characteristics of the lakes in and around Hydrabad.* _Envir. Hlth._ *7, 3; 1965; 177-87.*

Physico-chemical biological and bacteriological analysis of raw waters from Mir Alam tank, Hussain Sagar Osman Sagar and Himayat Sagar have been presented. The data collected for 1 year indicated that raw waters of Osman Sagar and Himayat Sagar, which serve as source of raw water to the city of Hydrabad are relatively free from pollution and are suitable sources of drinking water after conventional treatment. The waters might require special treatment with alum because of low turbidity.

212. *THAKUR (UC)etc. Chemical treatment of sewage. Indian J. Environ. Hlth. 19, 1; 1977; 16-29.*

There is a growing scarcity of fresh water due to increase in total demand and growing pollution of existing sources. This requires strict pollution control measures as also waste re use applications, necessiating purification of wastes to a high degree. Conventional biological secondry treatment alone fails to achieve this high degree of purification required, either for meeting the strict effluent criteria or for most reuse applications. Advanced treatment system have to be employed to achieve this. Chemical treatment forms an indispensible unit process of these systems. Chemical treatment of sewage does not seem to have been examined in this perspective in our country. In this paper, the reductions in raw sewage COD using alum, ferric chloride, ferrous sulphate and lime have been reported.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASURMENT, CHEMICAL, KANHAN.

213. *THERGAONKAR (VP) etc. Coagulation of Kanhan river water by aluminium and iron salts. Envir.Hlth. 10, 1; 1968; 16-20.*

Studies were carried out to find the efficiency of iron coagulants over aluminium sulphates. It was found that ferric chloride works better as a coagulant for the Kanhan river sediments on a bench scale, as its *doses are less than those of alum or ferric sulphate. The settling time can be reduced by seven minutes with better floc formation.*

214. *THERGAONKAR (VP) etc. Coagulation studies on Kanhan river sediments. Envir.Hlth. 9, 2; 1967; 126-32.*

The studies were carried out with particular reference to sediments collected from Kanhan river and its tributary Kolar. pH zone of best coagulation for sediments for Kanhan, black cotton and composite turbidity was found to be between 8-9; whereas for Kolar sediments, two such zones are observed, one between pH 4.5 to 7 and second between pH 9-10; The initial pH of Kolar suspension in distilled water was 8.4.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASUREMENT, BIOCHEMICAL.

215. *CHAKRABARTY (RN). Industrial waste treatment plants : their design & specifications. IAWPC Convention Vol. 3; 1976; 57-60.*

It would be desirable to equalize the waste discharges as much as possible before the same is subjected to treatment. Equalization period may vary from a few hours to about 24 hours depending upon the mode of discharge of the waste. Many industrial wastes may require chemical treatment before biological treatment is provided. Chemical treatment of an organic industrial waste also helps in the removal of certain organic components from the waste water; there by reducing the BOD and COD of the waste to a certain extent. Biological treatment is provided to a waste water which contains biodegradable organic matters.

216. *GUPTA (SC) etc. Disposal of distillery effluents. Indian Sug. 17, 1; 1967; 69-71.*

various methods of disposing of the distillery effluents have been discussed. Data has been presented on the biochemical process where in the nitrogenous organic matter is first converted into ammonia by use of ammonifying bacteria where in the acidity of the effluents get neutrilised by bacterial action without involving heavy chem. neutrilisation costs. In the second stage ammonia is allowed to get transformed and fixed into nitrites and nitrates by nitrification bacteria.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASUREMENT, PROCESSES.

217. ALAGARSWAMY (SR) etc. High rate deep stabilization pond for waste water treatment. Envir.Hlth. 9, 3; 1967; 241-53.

A lab. model has been fabricated to assess the comparative performance and economics of aerated stabilization process, over the conventional treatment plants. This new system could reduce the BOD of raw sewage by about 86.42 and 76.57% on the 3rd and 2nd day detention period and the suspended solid fell in the same periods by about 87 and 85%. It could handle more waste water/day unit vol. The area of the land required by this is less than that of the oxidation pond.

218. BASU (S). Applications of membrane techniques in waste effluent treatment for water and chemical reclamation alongwith pollution abatement. Chem. Age. India. 27, 12; 1976; 1086-91.

The membrane techniques offer great promise as a tertiary aid for the reclamation of water from waste effluents, along with elimination of biorefractory effluents.

219. BRILL (ED) and NAKAMURA (M). Regional waste water treatment systems in Japan. J. Water Poll. Cont. Fed. 50, 7; 1978; 1715-26.

Japan's rapid industrialization and urbanization in the last 30 years have created the need for better sewage systems and pollution control. The regional *systems typically consist of a small number of large control treatment plants for domestic and industrial wastes with large interceptor connecting many adjacent communities.*

220. *DAVE (JM) and JAIN (JS). Status of stabilization ponds in sewage treatment. Envir.Hlth. 8, 3; 1966; 228-50.*

The functioning of 33 stabilization ponds of the world comprising 8 of India, 5 of U.S.A., 9 of Australia, and 11 of Canada, has been discussed.

221. *DHABADGAONKAR (SM). Upflow clarification in industrial waste water treatment. J. Instn. Engrs. India. 56, 2; 1975; 80-4.*

The present status and the potentialities of the upflow clarification process are described and the various problems of operation of this process and the need for improvement of the process are pointed out. A tentative conceptual design of up flow unit to suit the needs, specifically of the small scale industries in India, is given.

222. *MAJUMDAR (NS) and GAJENDRA GADKAR (SK). Disposal of industrial waste by deep well injection. J. Instn. Engrs. India. 56, 1; 1975; 13-20.*

In deep well injection method, the liquid wastes are pumped down into aquifers below the ground surface from where they can not return to the surface. It is permissible to use this method where geological formations are satisfactory and wastes are compatible in quality and volume to the formation fluid. This method is particularly suitable for concentrated, toxic, radioactive and abnoxious wastes that can not otherwise be disposed of satisfactorily.

223. KATZ (R) etc. Pressure driven membraneeprocesses in the treatment of industrial effluents. Desalination. 24; 1-2-3; 1978; 113-28.

Three pilot plant studies showed that ultrafiltration and (or) reverse osmosis can almost totally separate both suspended and dissoloved solid from acquiring industrial effect. In the ultra filtration of cutting oil emulsions nearly oil free permeate was produced from emulsions of 20% concn.; a max oil concn. of 50% appears possible. Citrus fruit processing waste water was first treated by low pressure ultrafiltration to give a concn. which can be used as an animal feed supplement, the filtrate was treated by reverse osmosis at 40-50 atm. to give a concn. marketable to alc and yeast fermenters and a permeate which was almost sugar free. Reverse osmosis of H_2SO_4 - treated Kerosine was water with total solids content 14,000 ppm resulted in an overall rejection of 25% of total solids with a reasonable steady-state flux.

224. SHAH (CJ). Simplified sewage purification process for small quantities of domestic sewage and industrial wastes. J. Instn. Engrs. India. 46, 10; 1966; 175-81.

Details of process by which small quantity of sewage can be purified at such a cost that the process may find general adopting are given. The mechanism required is very simple, can be locally fabricated and does not require any skilled supervision.

INDUSTRIAL WASTE, RIVER POLLUTION, MEASURMENT, PROCESSES, GANGES.

225. JOSHI (HC). Observations on natural stabilization of city sewage in the river Ganga near Allahabad. IAWPC. Tech. Annual. 5; 1978; 157-9.

A case of natural stabilization of city sewage has been observed in the river Ganga near Allahabad. Results of *chemical analysis and B.O.D. tests of the sewage at different stages reveal that the rapid mineralisation of waste is due to formation of three large pools where the wastes are first collected, diluted and purified before ultimately meeting the river water.*

INDUSTRIAL WASTE, RIVER POLLUTION, EFFECTS, AQUATIC LIFE.

226. *AMIN (PM) and GANAPATI (SV). Occurrence of Zoogloca Colonies and protozoans at different states of sewage purification. Appl. Microbiol. 15, 1; 1967; 17-21.*

Samples of raw sewage, the effluent from the continous flow settling basin, the raw sludge, the flowting seumin the settling basin, the final secondry digested sludge, and the supernatantliquid from the secondry digester were kept without any disturbance in 1-litre Pyrex glass beakers, which were loosely covered with Petridishes. It is not known wheather the Zoogloca Colonies discovered in the above cases are the same as ordifferent from the typical Z. ramigera of activated sludge, and whether they are slime-forming or flocculent types of bacteria.

227. *BARTSCH (AF). Biological aspects of stream pollution. Sew. Works Jour. 20, 2; 1948; 292-302.*

Living organisms are affected by the conditions of stream pollution. Their distribution is altered and may be used to complete the pollutional picture obtained by the usual testing procedures. Their activities contribute tremondously to stream recovery by using pollutants as a source of energy and growth material. A good treatment plant at wind mill would confine these activities and restore utility to the running stream.

228. *CHEN (CW). Effects of San Diego's waste water discharge on the ocean Environment. Jour. Water Poll. Control Fed. 42, 8(pt 1); 1970; 1458-67.*

Information derived from data collected in the ocean environment near the city of San Diego Waste Water out fall included variance and time series analyses to discern physical, chemical and biological changes and population trend and composition of biota. The benthic populations were stimulated by the waste discharge and the deposit of organic matter.

229. *FOEHRENBACH (J). Pollution and eutrophication problems of Great South Bay, Long Island, New York.* *__Jor. Water Poll. Control Fed__. 41, 8(pt 1); 1969; 1456-66.*

Great South Bay is located between New York City and Montank point.- Although the bay has a large assimilative capacity for some forms of pollution. It is reaching a point where additional loads will affect adversely its ecology, economic and recreational value.

230. *GAUFIN (AR) and TARZWELL (CM). Aquatic macro-invertebrate communities as indicators of organic pollution in Lytle Greek.* *__Sew. & Ind. Waste__. 28, 7; 1956; 906-24.*

Intensive studies were carried out on Lytle Greek to discover the effects of sewage pollution on the communities of the stream and the value of these populations as indicators of present and past pollutional conditions. In these investigations physical chemical conditions were related to the qualitative and quantitative composition of the aquatic populations in the different life zones.

231. *HEUKELEKIAN (H) and CROSBY (ES). Slime formation in polluted water.II. Factors affecting slime growth.* *__Sew. & Ind. Waste__. 28, 1; 1956; 78-92.*

Laboratory and field studies were made to evaluate the influence of certain factors on slime formation in sewage effluents after various degrees of purification, and in stream waters.

232\. HUANG (JC). Effect of selected factors on Pesticide Sorption and desorption in the aqutic system. Jour. Wat.Poll.Control Fed. 43, 8; 1971; 1739-48.

The effect of pH, temperature, salt (Nacl) concn. and several representative organic pollutants on the sorption and desroption of chlorinated hydrocarbon pesticides by aquatic clay sediment was investigated. None of these selected factors seem to exert any significant influence on pesticide uptake and release by the aquatic sediment.

233\. MACKENTHUN (KM). Biological evaluation of polluted streams. Jour. Water Poll. Control Fed. 38, 2; 1966; 241-7.

The biological evaluation is an important tool for use in all stream pollution investigations. By comparing the kinds and numbers of aquatic animals and plants found in an unpolluted stream reach with those found in a polluted reach, a clear picture of the effécts of the pollution on the aquatic life of the stream can be obtained.

234\. MALL (LP) etc. Influence of industrial pollutants on pigment concentration of some Angiosperm Flora. Indian J.Environ.Hlth. 19, 4; 1977; 365-7.

The paper describes the effect of industrial pollutants on the pigment concentration of some angiosperm flora in an industrial locality at Ujjain. Significant changes were found in the pigment concentration of the plants present at the polluted and the non polluted areas. The most severely affected plants at the polluted area were cassia tora, Ipomea Crassiculis. Cynodon dactylon in which there was more than 50% decrease in the pigment concentration, in comparison to the plants at the unpolluted areas. Cyperus rotundus and saccharum spontaneanum appear to be the most tolerant species.

235. TARZWELL (CM) and GAUFIN (AR). Some important biological effects of pollution often disregarded in stream surveys. Proc. Ind. Waste Conf. 8, 295; 1954; 117-23.

It points out some of the possible effects of pollution on aquatic life and indicate environmental conditions which should be noted in stream surveys. Pertinent comments are made on the use and value of biological indicators of pollution.

236. VERMA (SR) etc. Pollution studies of few rivers of western Uttar Pradesh with reference to biological indices. Proc. Ind. Acad.Sci. 87B, 6; 1978; 123-31.

Pollution studies of four rivers of Western Uttar Pradesh and physico-chemical and biological character at 16 sampling points and the correlation between them have been made. It is observed that the species number (W) and the total number of organisations of the phytoplankton though exihibit a relationships at certain stretch with the increase or decrease of pollution intensity yet it is not found very specific and so no definite conclusion could be made.

237. VITTAL RAO (M) and KRISHNA MOORTHI (KP). Prefrential devouring of blue-green algae by a Daphnid Moina Dubia. Indian J. Environ Hlth. 19, 2; 1977; 143-4.

When organisms like daphnids and rotifers appear in blooming proportion, they devour the entire algal population present in that water body with in a short time. The conditions responsible for their sudden blooming are not clearly understood. To see the preferential feeding habits of Moina dubia in a naturally existing mixed algal population, stabilization pond waters having the algae chlorella, scenedesmus, Merismopedia. The results showed that feeding habits of Moina dubia may bemore due to cell morphology of the the algal species rather than to the presence of any repulsive substance in these alga cells. Moina dubia could be used to polish the algae intertiary ponds or led into fish ponds.

238. WALDICHUK (M). Effects of pollutants on marine organisms; improving methodology of evaluation-a review of the literature. Jour. Water Poll. Control Fed. 41, 9; 1969; 1586-1601.

Improvement in pollution control requirs that methods of parameter evaluation be improved. The paper is devoted to the marine environment and (a) the problems of water pollution and (b) a review of some of the advances made in recent years in techniques to solve these problems.

INDUSTRIAL WASTE, RIVER POLLUTION, EFFECTS, AQUATIC LIFE, CHRISTINA.

239. SHANE (MS) etc. Pollution effects on Phycovirus and host algae ecology. Jour. Water Poll. Control Fed. 44, 12; 1972; 2294-2302.

Chemical, Physical and Biological parameters of pollution were measured at 11 stations along the Christina River (Dilaware). The stations were located from source to mouth. The purpose was to determine the distribution of Lyngbya, Phormidium and Plactonema viruses in relationship to pollution.

INDUSTRIAL WASTE? RIVER POLLUTION, EFFECTS, AQUATIC LIFE, DUWAMISH.

240. WELCH (Eugene B). Phytoplankton and related water quality conditions in an enriched estuary. Jour. Water Poll. Control Fed. 40, 10; 1968; 1711-27.

A study of phytoplankton and their relation to nutrient concns. in the Duwamish Estuary at seattle, washington, was conducted from July 1964 to Dec. 1965. The effects of effluent discharge from a secondry treatment plant on the increased growth of the organisms were recorded.

Results indicate that while plant effluent significantly increased estuarine nutrient concns., algae bloom also was dependent on other factors e.g. fresh water discharge. Phytoplankton production contributed to DO content.

<u>INDUSTRIAL WASTE, RIVER POLLUTION, EFFECTS, AQUATIC LIFE, HOOGHLY, MATLAH</u>.

241. *BASU (AK). Observation on the probable effects of pollution on the primary productivity of the Hooghly and Matlah estuaries. <u>Hydrobiologia</u>. 25, 1-2; 1965; 302-16.*

By the use of the light and dark bottles technique, a comparative study of the productivity of the Hooghly and Matlah estuaries was made. The Hooghly estuary is a recipient of various pollutants from industries located on its banks, whereas the Matlah is free from pollutants.

<u>INDUSTRIAL WASTE, RIVER POLLUTION, EFFECTS, AQUATIC LIFE, YAMUNA</u>.

242. *CHANDRA PRAKASH etc. Ecological study of the river Jamuna. <u>IAWPC Tech. Annual</u>. 5; 1978; 32-45.*

An investigation of the role of planktons, in a stretch of 6 kms. of river Jamuna (Polyaghat to Jawahar bridge) was carried out. The main features of the ecological significance of the river are the siltladen water flow which varies from maximum in fains to minimum in summer. These seasonal variations of the river are also affecting the vicinity, plants and animals. The physio chemical and biological studies express positively the high organic enriched situation of the river Jamuna water at Agra, reflecting the pollution scene, increases progressively due to the waste water discharge.

INDUSTRIAL WASTE, RIVER POLLUTION, EFFECTS, FISH LIFE.

243. *HALLOCK (RJ) and ZIEBELL (CD). Feasibility of a sport Fishery in tertiary treated waste water. Jour. Water Poll. Control Fed. 42, 9; 1970; 1656-65.*

The objective of this study was to test the feasibility of developing a sport fishery in tertiary treated domestic waste water. Fish tested were channel cat fish, Ictalurus, punctatus, rainbow trout, salmogairdneri and Malacca Tilapia hybrides. Less than 1% survival occured in five trout experiments and in one cat fish experiment. An important cause of death was low oxygen sunrise tensions.

244. *MATHUR (RP). Bacteriological studies of treated and untreated waters at Chandrawal water works, Delhi. Envir. Hlth. 7, 4; 1965; 189-95.*

The bacterial count of raw water of a water works varied between 93 X 10^4/100 ml. During the monsoon months of July to Sep., the bacterial load shoots up manifold making water unsuitable to be used as raw water in public water supply as per objective laid down by various authorities. The efficiency, max. during rainy season depends upon initial raw water load and the turbidity removal.

245. *REKHA SARKAR and KRISHNA MOORTHI (KP). Diurnal variation studies of Zooplankton in sewage fertilized fish pond-Nagpur. Indian J. Environ Hlth. 20, 4; 1978; 366-89.*

The diurnal vertical migration of Zooplankton in sewage fertilized fish ponds at Nagpur were investigated for a period of eitht months covering three seasons. The diurnal changes in temperature, pH and dissolved oxygen of both the surface and bottom layers were also recorded simultaneously since these are important parameters for fish survival and growth. This study was undertaken with a view to determine the various aspects connected with the promotion of fish culture using sewage fertilised fish pond.

INDUSTRIAL WASTE, RIVER POLLUTION, EFFECTS, FISH LIFE, MEASURMENT, CHALIYAR.

246. *PRASAD (VS) and SUBRMONIA (IK). Pollution of Chaliyar river - a study. J. Instn. Engrs. India. 57, 1; 1976; 27-31.*

A study was conducted from July 1973 to March 1975 to assess the extent of pollution in the Chaliyar. It was found that the water is fit for all domestic uses during the monsoon season. The discharge of the factory effluent makes it unfit for fish culture and as a raw water for community water supplies during the summer season. However, the river is fit for irrigation and navigation purposes at all times. Suitably remedial measures for the pollution problems are also suggested.

INDUSTRIAL WASTE, RIVER POLLUTION, EFFECTS, FISH LIFE, MEASURMENT, KALI.

247. *GEORGE (MG) etc. A limnological survey of the river Kali with reference to fish mortality. Environ Hlth. 8, 4; 1966; 262-9.*

A survey of the river Kali was conducted in order to assess the extent of damage caused to fish life due to pollution. It has been found that river is grossly polluted due to the industrial wastes let into it from different factories in the region. It is suggested that measures should be taken to abate the pollution.

INDUSTRIAL WASTE, RIVER POLLUTION, EFFECTS, ALGAE.

248. *McINTIRE (CD). Physiological-Ecological studies of Benthic Algae in Laboratory streams. Jour. Water Poll. Control Fed. 40, 11; 1968; 1940-52.*

Laboratory streams, a resprirometer chamber and Warburg apparatus were used to study the physiological ecology of benthic, algal communities in flowing water environments. Abundance of the different algal species depends on chemical and physical fluctuations of light intensity and current velocity. Peliphyton accumulated most rapidly at high light intensities and current velocities.

249. PARHAD (NM) and RAO (NU). Effect of algal growth on the survival of E.Coli in sewage. Indian J. Envtron Hlth. 14, 2; 1972; 131-9.

Four types of experiments were carried out using E. Coli with (i) uni-algal culture of chlorella (ii) uni-algal cultures of different algae (iii) unialgal culture of chlorella at different intensities of light and (iv) unialgal culture of chlorella in unbuffered and buffered sewage, to find the relationship between the algal growth and E.Coli reduction in sewage. E.Coli-grew in sterile sewage as it grows in a nutrient medium.

INDUSTRIAL WASTE, RIVER POLLUTION? EFFECTS, ALGAE, MINNESOTA.

250. MILLER (WE) and MALONEY (TE). Effects of secondry and Tertiary waste water effluent on algal growth in a Lake-River System. Jour. Wat. Poll. Control Fed. 43, 12; 1971; 2361-5.

The biostimulatory effects of secondry and tertiary treated waste water effluent were determined on the Shagwa Lake-Burnt side river system in Minnesota. Chemical characteristics of the river were consistent year-round and supported growth of test algae in concentration of 5 X 10^3 cells/ml. Lake water supported algal growth and correlation was shown between algal growth responses and N and P content of lake water samples.

INDUSTRIAL WASTE, RIVER POLLUTION, PHYSICO-CHEMICAL CHANGES, GANGES.

251. *AGARWAL (DK) etc. Physico-chemical characteristics of Ganges water at Varanasi. Indian J. Envir. Hlth. 18, 3; 1976; 201-6.*

Study of the various physico-chemical indicators of faecal pollution of Ganges water at bathing ghats and sewage out falls was carried out during 1972-73 at Varanasi. The values observed are compared with stand ards laid down by various authorities for river water for human use. Data indicated that the water at the bathing ghats was fairly clean probabely due to high dilutions altering in summer at certain down stream ghats and at Assighat the quality of water tended to deteriorate bringing it to a doubtful quality.

INDUSTRIAL WASTE, RIVER POLLUTION, PHYSICO-CHEMICAL CHANGES, KALI.

252. *AJMAL (M) etc. Studies on river pollution of Kalinadi. Science and environment. 1, 2; 1979; 149-54.*

The waters of Kalinadi during their travel of 417 km. receive considerable amount of industrial effluents and sewage wastes from Muzaffarnagar, Meerut (1) Bulandshahr and Aligarh districts. The river is badly effected by Modinagar industrial complex whose complex reaches to Kakdrabad (2) drain and finally to Kalinadi after running over a distance of about 32 Km. near village Hirdayanagar in Bulandshahr district. The colour of river is black having an organic smell and its attains alkalinity throughout from Bulandshahr to Atrauli. The values of D.O., BOD, COD temperature and ammonia nitrogen are dependent on the seasons. In winter high BOD and COD are observed while DC is low due to sugar cane crushing season. The results of the investigation of calender year 1978- are presented on this paper.

PART III

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